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W. H. M. CHRISTIE, M.A., F.R.S., President, in the Chair.

Arthur Berry, B.A., King's College, Cambridge; and
The Rev. Walter Edward Stewart, M.A., 1 Banks Terrace, Croft-on-Tees, Darlington,

were balloted for and duly elected Fellows of the Society.

The following candidates were proposed as Fellows of the Society, the name of the proposer from personal knowledge being appended:—

Thomas Dallmeyer, 18 Bloomsbury Street, W.C. (proposed by Capt. W. de W. Abney);
George Wilson Heath, F.R.G.S., Scientific Instrument Manufacturer, Bexley, Kent (proposed by J. R. Jones);
Alfred Robert Johnson, M.A., St. John's College, Cambridge (proposed by H. H. Turner);
Reginald Carter Nelson, Solicitor, 19 Roker Terrace, Sunderland (proposed by Cuthbert Hutchinson);
Sir Henry Thompson, M.B., 35 Wimpole Street, W. (proposed by A. A. Common);
John Walther, M.D., C.M. Edin., West House, Eastbourne (proposed by John Browning).

The Numerical Lunar Theory.

(Extract from a letter from Sir G. B. Airy to Mr. Knobel.)

In my Numerical Lunar Theory, Section VI., page 76, I remarked that there were difficulties in the lunar theory which I had not overcome; and which I naturally attributed to some error of my own mathematical work. I have now discovered the error.

In page 11, I assumed the existence of a solar term, with a coefficient which I called M, and which I supposed to exercise an influence on the lunar motions. I was not justified in this assumption, and I withdraw it entirely.

It is necessary now to modify the text of some of the following sections, and to substitute in several places new piles of figures for those which I had furnished. The work will be considerable, and must be done, in a great measure, by myself. However, I have already taken some steps for effecting it. I can only report at present that page 11 is to be entirely expunged. But I hope this day to give instructions to computers.

The White House, Croom's Hill, Greenwich Park:
1888, *March* 23.

Orbit of the Binary Star λ Ophiuchi. By Professor S. Glasenapp.

(*Communicated by E. Dunkin, F.R.S.*)

The observations of this binary star, made by several observers during the last sixty-two years, show a direct motion for the component. This motion can be easily seen from the following measurements which we select from a long series of observations :—

Epoch.	θ	σ	Observer.
1825·51	331°·4	0″·8	W. Struve.
1828·64	341·3	0·8	J. Herschel, W. Struve.
1840·55	357·9	1·0	O. Struve, Bishop.
1853·52	13·3	1·3	O. Struve, Dawes, Smyth.
1861·61	20·9	1·3	O. Struve, Mädler.
1868·57	27·1	1·4	O. Struve, Dunér, Dembowski, Main.
1877·51	33·6	1·5	O. Struve, Dembowski, Jedrzejewicz, Doberck.
1886·58	42·0	1·5	A. Hall, Jedrzejewicz.

Now the observations of W. Herschel (*Phil. Trans.* 1804, Part II. p. 374) :—

1783·18	75°·5	±0″·50
1802·39	69°·3	—

indicate a retrograde motion of about 6° in 19 years; therefore it is evident that one of these observations or both of them are erroneous. Several astronomers have tried to restore these observations, and have supposed that the true measurements may be read as follows :—

Year.	W. Struve.	Mädler, Hind, Dawes.	O. Struve.	R. Engelmann.	Flammarion.
1783	255°·5	75°·5	75°·5	205°·5	284°·5
1802	69·3	249·3	110·7	249·3	290·7

As these observations are of great value in the investigation of the orbit of λ *Ophiuchi*, I believe that the following considerations may throw some light on the true positions of the component star in these observations.

I find that W. Herschel's original observations are noted as follows :—

For 1783 ... ... 14° 30′ *nf* ($\theta = 75°{\cdot}50$)
For 1802 ... ... 20° 41′ *sf* ($\theta = 110°{\cdot}7$)

and that the angles are counted from the parallel-circle. If we suppose that only an error in writing has occurred in the entry of the observations, and that instead of *nf* we could put *sf*, or *np*, or *sp*, we should obtain for each epoch four positions of the component star; one of these will be the true observation. These values are the following :—

If we write	*nf*	we shall have	75°·5	for 1783;	69°·3	for 1802.
„	*sf*	„	104·5	„	110·7	„
„	*sp*	„	255·5	„	249·3	„
„	*np*	„	284·5	„	290·7	„

As we do not know which of these four values for each epoch is the true one, we may suppose that the true observations are included in the following 16 combinations of the preceding angles :—

No.	1783.	1802.	No.	1783.	1802.
1	75°·5	69°·3	9	255°·5	69°·3
2	75·5	110·7	10	255·5	110·7
3	75·5	249·3	11	255·5	249·3
4	75·5	290·7	12	255·5	290·7
5	104·5	69·3	13	284·5	69·3
6	104·5	110·7	14	284·5	110·7
7	104·5	249·3	15	284·5	249·3
8	104·5	290·7	16	284·5	290·7

Eight of these combinations, Nos. 1, 5, 9, 10, 11, 13, 14, and 15 indicate a retrograde or a very rapid direct motion, which is not confirmed by the observations of the last 62 years; therefore these combinations must be rejected as improbable.

Four combinations, Nos. 3, 4, 7, and 8, indicate a very rapid direct motion, which is not confirmed by the observations of the last 62 years; they must also be rejected as improbable.

Finally, the two combinations Nos. 6 and 16 indicate a too small direct motion, which is also not confirmed by the later observations; for the same reason they must also be rejected.

There are left only the two following combinations under Nos. 2 and 12 :—

	1783.	1802.
No. 2	75°·5	110°·7
No. 12	255°·5	290°·7

which indicate a possible direct motion of 35° in 19 years. If we remember that the distance in 1783 is equal to 0″·5 we can only admit the last combination, No. 12. Indeed, the observations of the last 62 years indicate an increase of distance between the components, and when θ will be equal to 75° the distance may be probably 1″·7, but not 0″·5 as it was in 1783. Therefore, only one combination, which is noted under No. 12, can be admitted as the most probable on the supposition that W. Herschel's observations are affected with an error in writing.

N.B.—The distance in 1783 is only an estimate, and may have been as large as 1″·5.

If we add these two observations (combination No. 12) to the observations made during the last 62 years, we obtain the beautiful series of measurements, contained in the following table, in which the angles of position are reduced to the circle of 1900.

Epoch.	θ	σ	Epoch.	θ	σ
	°	″		°	″
1783·18	254·9	±0·5 (est.)	1853·52	13·3	1·3
1802·39	290·2	—	1861·61	20·9	1·3
1825·51	331·4	0·8	1868·57	27·1	1·4
1828·64	341·3	0·8	1877·51	33·6	1·5
1840·55	357·9	1·0	1886·58	42·0	1·5

From these observations we obtain the following system of elements of the orbit :—

T = 1787·9	λ = 152°·5 Eq. 1900
U = 373·5 years	i = 38°·1
n = +0°·9638	e = 0·4424
Ω = 105°·5 Eq. 1900	a = 1″·53

These elements represent very well the above-mentioned observations. The following table contains the comparison of the computed values with the observed :—

Epoch.	θ_o	θ_c	$\theta_o - \theta_c$	σ_o	σ_c	$\sigma_o - \sigma_c$
	°	°	°	″	″	″
1783·18	254·9	251·5	+3·4	±0·5	0·8	—
1802·39	290·2	294·1	−3·9	—	—	—
1825·51	331·4	334·4	−3·0	0·8	1·0	−0·2
1828·64	341·3	339·3	+2·0	0·8	1·0	−0·2
1840·55	357·9	356·4	+1·5	1·0	1·1	−0·1
1853·52	13·3	12·4	+0·9	1·3	1·2	+0·1
1861·61	20·9	20·9	0·0	1·3	1·3	0·0
1868·57	27·1	27·5	−0·4	1·4	1·3	+0·1
1877·51	33·6	35·0	−1·4	1·5	1·4	+0·1
1886·58	42·0	41·8	+0·2	1·5	1·5	0·0

These elements must be certainly considered as a first approximation only.

Observatoire de l'Université Impériale,
St. Petersburg: February 1888.

Southern Double Stars. By the Rev. S. J. Johnson, M.A.

Although there do not seem to be any published measures of southern double stars at very low altitudes in this country, yet there are a few interesting objects which do not deserve to be neglected, and of which measures not quite without value can be got by an observer situated on the extreme south coast of England, if he will watch for the few favourable opportunities of a clear horizon when the star is near its highest attainable altitude in our land. The following are a few specimens of objects of this kind taken with a filar micrometer on a $3\frac{1}{4}$-inch equatorial during the last few years. The mean of four measures in each case is given.

No.	Year.		Position-angle.	Distance.
			°	″
1	1881·92	ω Fornacis	240·3	10·4
2	1882·12	H 3945	66·9	—
3	1886·34	3 (κ) Centauri	109·4	7·6
4	1887·23	ξ Antliæ	209·0	10·0
5	1887·37	*f* Hydræ	189·4	12·4

Distance measurements of (2) could not be got. Very little illumination could be used. The colours of (2) are fine and prominent: red, blue. The companion of 3 (κ) *Centauri* seems to have a bluish tint. Measures of ξ *Antliæ* were rather discordant, but the mean good. The lat. of this place is about 50° 46′ 10″.

Melplash Vicarage, Dorset:
1888, *March* 7.

On the Orbit of 70 (*p*) *Ophiuchi.* By J. E. Gore.

As none of the orbits hitherto published for this interesting binary star represent recent measures satisfactorily, I have computed an orbit, using all available measures from 1819 to 1887, about 247 in number, and find the following provisional elements:—

Elements of 70 *Ophiuchi.*

P = 87·84 years.	☊ = 120° 5′ (1880·0)
T = 1807·65	λ = 171° 45′
e = 0·4912	*a* = 4″·50
γ = 58° 28′	*u* = −4°·098

The following is a comparison between the recorded measures and the positions computed from the above elements. The observed position-angles have been corrected for the effect of precession to 1880·0 :—

Epoch.	Observer.	0_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$
1779·76	Sir W. Herschel	89°·45	99°·38	(−9°·93)	3″·6	5″·23	−1″·63
1780·49	,,	...	...	...	4·4	5·12	−0·72
1781·73	,,	98·66	96·50	+2·16			
1802·25	,,	335·67	337·94	−2·27			
1804·41	,,	318·38	319·37	−0·99			
1819·64	Struve	168·17	168·12	+0·05			
1820·77	,,	159·87	162·15	−2·28			
1821·31	Herschel & South	155·88	159·73	−3·85	3·68	2·95	+0·73
1821·74	Struve	157·28	157·92	−0·64			
1822·42	Herschel & South	154·48	154·37	+0·11	4·85	3·27	+1·58
1822·64	Struve	153·58	153·86	−0·28			
1823·35	Herschel & South	153·29	152·23	+1·06			
1825·57	,,	147·80	146·18	+1·62	4·765	4·00	+0·765
1827·02	Struve	144·81	143·00	+1·81	4·37	4·32	+0·05
1827·51	Herschel & South	141·71	142·06	−0·35	5	4·42	+0·58
1828·71	Struve	139·92	139·87	+0·05	4·78	4·68	+0·10
1829·59	,,	137·72	138·40	−0·68	5·08	4·84	+0·24
1830·36	Herschel & South	137·83	137·30	+0·53	5·95	4·98	+0·97
1830·41	Bessel	135·33	137·22	−1·89	5·45	4·99	+0·46
1830·57	Dawes	137·13	136·98	+0·15	5·53	5·02	+0·51
1830·69	Bessel	135·43	136·79	−1·36	5·51	5·01	+0·50
1830·76	Smyth	136·17	136·68	−0·51	5·43	5·06	+0·37
1830·84	Struve	135·43	136·56	−1·13	5·31	5·08	+0·23
1831·52	Herschel & South	135·83	135·51	+0·32	5·97	5·19	+0·78
1831·68	Struve	134·43	135·31	−0·88	5·41	5·22	+0·19
1832·55	Dawes	132 44	134·20	−1·76	5·71	5·37	+0·34
1832·57	Herschel & South	135·24	134·18	+1·06	5·49	5·37	+0·12
1832·75	Struve	133·64	133·95	−0·31	5·55	5·39	+0·16
1833·42	Dawes	132·54	133·01	−0·47	6·14	5·49	+0·65
1833·59	Smyth	132·24	132·78	−0·54	6·0	5·53	+0·47
1834·47	Struve	130·85	131·72	−0·87	5·85	5·65	+0·20
1834·57	Dawes	130·35	131·60	−1·25	6·12	5·66	+0·46
1835·56	Smyth	130·36	130·46	−0·10	5·97	5·74	+0·23
1835·60	,,	130·56	130·42	+0·14	6·11	5·75	+0·36
1835·60	Struve	130·46	130·42	+0·04	6·10	5·75	+0·35

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
		°	°	°	″	″	″
1836·50	Encke	127·76	129·42	−1·66	6·46	5·91	+0·55
1836·65	Herschel & South	129·06	129·26	−0·20	6·97	5·93	+1·04
1836·66	Struve	129·26	129·25	+0·01	6·13	5·93	+0·20
1836·81	Smyth	128·36	129·10	−0·74	6·19	5·95	+0·24
1837·46	Encke	127·97	128·42	−0·45	6·72	6·06	+0·66
1837·64	Smyth	127·27	128·23	−0·96	6·26	6·06	+0·20
1838·51	„	126·27	127·33	−1·06	6·25	6·13	+0·12
1838·56	Encke	126·37	127·28	−0·91	6·63	6·13	+0·50
1839·51	„	124·98	126·35	−1·37	6·78	6·25	+0·53
1839·65	Dawes	125·58	126·22	−0·64	6·55	6·27	+0·28
1839·87	Encke	125·48	126·00	−0·52	6·34	6·30	+0·04
1840·35	Kaiser	127·68	125·55	+2·13	6·00	6·32	−0·32
1840·59	Dawes	124·58	125·33	−0·75	6·62	6·33	+0·29
1840·75	O. Struve	126·88	125·18	+1·70	6·59	6·34	+0·25
1841·44	Mädler	125·19	124·54	+0·65	6·45	6·44	+0·01
1841·65	O. Struve	125·69	124·34	+1·35	6·65	6·43	+0·22
1841·68	Dawes	123·19	124·31	−1·12	6·63	6·42	+0·21
1841·74	Kaiser	123·19	124·26	−1·07	6·53	6·42	+0·11
1842·39	Mädler	124·19	123·65	+0·54			
1842·53	Dawes	123·09	123·53	−0·44	6·72	6·46	+0·26
1842·55	Smyth	122·19	123·51	−1·32	6·64	6·46	+0·18
1842·59	Kaiser	122·39	123·48	−1·09	6·48	6·47	+0·01
1842·62	Challis	124·79	123·46	+1·33	5·86	6·47	−0·61
1842·66	Mädler	124·49	123·42	+1·07	6·25	6·47	−0·22
1842·70	O. Struve	124·49	123·38	+1·11	6·62	6·47	+0·15
1843·53	Mädler	123·10	122·64	+0·46	6·42	6·52	−0·10
1843·56	Challis	123·30	122·62	+0·68	6·69	6·52	+0·17
1843·72	Mädler	122·30	122·48	−0·18	6·43	6·53	−0·10
1844·57	„	121·80	121·72	+0·08	6·48	6·58	−0·10
1844·59	Challis	121·30	121·70	−0·40	5·96	6·58	−0·62
1844·71	O. Struve	121·30	121·60	−0·30	6·62	6·59	+0·03
1845·43	Herschel & South	120·61	120·97	−0·36	6·77	6·62	+0·15
1845·54	Mädler	120·61	120·88	−0·27	6·58	6·62	−0·04
1845·68	O. Struve	120·71	120·76	−0·05	6·55	6·62	−0·07
1846·01	Jacob	120·21	120·48	−0·27	6·83	6·63	+0·20
1846·46	Hind	119·91	120·08	−0·17	6·14	6·64	−0·50
1846·56	Durham Obs.	116·91	120·00	−3·09	7·43	6·64	+0·79
1846·57	Mädler	119·61	120·00	−0·39	6·64	6·64	0·0
1846·73	O. Struve	121·11	119·86	+1·25	6·61	6·64	−0·03

Epoch.	Observer.	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$
		°	°	°	″	″	″
1847·45	Durham Obs.	117·02	119·25	−2·23	7·19	6·66	+0·53
1847·48	Smyth	119·52	119·23	+0·29	6·8	6·66	+0·14
1847·59	Mitchell	120·12	119·14	+0·98	5·53	6·66	−1·13
1847·76	O. Struve	119·52	118·99	+0·53	6·50	6·66	−0·16
1848·12	Dawes	118·62	118·68	−0·06	6·80	6·67	+0·13
1848·50	Mädler	118·03	118·35	−0·32	6·83	6·65	+0·18
1848·52	Bond	117·93	118·32	−0·39	6·9	6·65	+0·25
1848·52	,,	117·53	118·32	−0·79	6·8	6·65	+0·15
1848·79	O. Struve	118·33	118·11	+0·22	6·78	6·65	+0·13
1849·78	,,	117·63	117·27	+0·36	6·54	6·64	−0·10
1850·48	Jacob	114·94	116 67	−1·73	6·86	6·63	+0·23
1850·64	Mädler	116·54	116·53	+0·01	6·94	6·63	+0·31
1851·47	,,	115·24	115·83	−0·59	6·67	6·62	+0·05
1851·67	O. Struve	115·24	115 66	−0·42	6·52	6·62	−0·10
1851·74	Mädler	115·34	115·60	−0·26	6·67	6·62	+0·05
1852·44	Smyth	114·75	115·01	−0·26	...	6·61	
1852·67	O. Struve	114·85	114·82	+0·03	6·55	6·61	−0·06
1852·73	Mädler	114·55	114·77	−0·22	6·56	6·61	−0·05
1852·74	Jacob	113·85	114·77	−0·92	6·73	6·61	+0·12
1853·54	Dembowski	116·25	114·05	+2·20	6·45	6·60	−0·15
1853·60	Dawes	116·45	114·00	+2·45	6·48	6·60	−0·12
1853·76	Mädler	113·15	113·86	−0·71	6·56	6·59	−0·03
1853·78	O. Struve	113·45	113·84	−0·39	6·47	6·59	−0·12
1854·08	Jacob	113·46	113·58	−0·12	6·36	6·58	−0·22
1854·58	Dembowski	113·36	113·15	+0·21	6·26	6·56	−0·30
1854·68	Mädler	113·16	113·06	+0·10	6·31	6·56	−0·25
1854·69	O. Struve	112·66	113·06	−0·40	6·54	6·56	−0·02
1854·73	Dawes	113·56	113·02	+0·54	6·33	6·56	−0·23
1855·21	Dembowski	112·96	112·59	+0·37	6·52	6·53	−0·01
1855·45	Secchi	111·46	112·30	−0·84	6·25	6·52	−0·27
1855·66	O. Struve	111·76	112·05	−0·29	6·49	6·50	−0·01
1855·66	Dawes	112·46	112·05	+0·41	6·51	6·50	+0·01
1855·69	,,	113·06	112·01	+1·05	6·46	6·50	−0·04
1856·12	Jacob	111·77	111·87	−0·10	6·45	6·47	−0·02
1856·37	,,	111·27	111·57	−0·30	6·39	6·45	−0·06
1856·50	Mädler	111·37	111·35	+0·02	6·32	6·44	−0·12
1856·63	Dembowski	111·57	111·33	+0·24	6·40	6·43	−0·03
1856·73	O. Struve	111·57	111·22	+0·35	6·37	6·43	−0·06
1857·13	Jacob	110·47	110·66	−0·19	6·46	6·40	+0·06

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1857·42	Fletcher	112°·18	110°·46	+1°·62	6″·36	6″·38	−0″·02
1857·57	Dawes	109·88	110·29	−0·41	6·38	6·37	+0·01
1857·58	,,	110·08	110·28	−0·20	6·52	6·37	+0·15
1857·63	Dembowski	109·38	110·22	−0·84	6·31	6·37	−0·06
1857·67	Morton	109·98	110·19	−0·21	6·15	6·37	−0·22
1857·69	O. Struve	109·98	110·18	−0·20	6·40	6·37	+0·03
1858·12	Jacob	109·58	109·88	−0·30	6·10	6·33	−0·23
1858·39	Morton	108·48	109·68	−1·20	6·08	6·30	−0·22
1858·44	Dembowski	109·18	109·65	−0·47	6·09	6·30	−0·21
1858·63	Mädler	108·78	109·47	−0·69	5·94	6·28	−0·34
1858·72	O. Struve	108·68	109·38	−0·70	6·21	6·27	−0·06
1859·68	,,	108·38	108·45	−0·07	6·19	6·21	−0·02
1859·72	Dawes	109·18	108·41	+0·77	6·24	6·21	+0·03
1859·75	Auwers	108·88	108·38	+0·50	6·61	6·21	+0·40
1860·61	Secchi	106·19	107·53	−1·34	6·07	6·12	−0·05
1860·74	Auwers	107·79	107·40	+0·39	6·49	6·11	+0·38
1861·46	Main	106·90	106·65	+0·25	5·89	6·03	+0·14
1861·63	O. Struve	106·30	106·48	−0·18	5·88	6·01	−0·13
1861·97	Mädler	105·90	106·12	−0·22	5·85	5·97	−0·12
1862·62	Dembowski	105·40	105·43	−0·03	5·73	5·90	−0·17
1862·72	Mädler	105·10	105·33	−0·23	5·70	5·89	−0·19
1862·77	O. Struve	105·10	105·28	−0·18	5·85	5·88	−0·03
1863·5	Wash. Obs.	106·11	104·45	+1·66	5·19	5·86	−0·67
1863·5	,,	106·81	104·45	+2·36	5·74	5·86	−0·12
1863·5	,,	106·21	104·45	+1·76	6·04	5·86	+0·18
1863·5	,,	105·81	104·45	+1·36	5·87	5·86	+0·01
1863·5	,,	104·91	104·45	+0·46	5·72	5·86	−0·14
1863·5	,,	104·71	104·45	+0·26	5·74	5·86	−0·12
1863·51	Dembowski	104·11	104·45	−0·34	5·60	5·80	−0·20
1863·55	Romberg	104·41	104·41	0·0	5·76	5·80	−0·04
1864·48	Engelmann	104·71	103·35	+1·36	5·42	5·67	−0·25
1864·60	Dembowski	103·41	103·21	+0·20	5·46	5·67	−0·21
1865·51	,,	102·22	102·13	+0·09	5·37	5·53	−0·16
1865·53	Romberg	104·42	102·11	+2·31	5·30	5·53	−0·23
1865·55	,,	103·82	102·08	+1·74	5·24	5·53	−0·29
1865·62	Kaiser	100·52	101·99	−1·47	5·31	5·52	−0·21
1865·72	O. Struve	102·62	102·86	−0·24	5·32	5·50	−0·18
1865·80	,,	101·12	101·76	−0·64	5·26	5·49	−0·23
1866·49	Talmage	101·73	100·86	+0·87	5·26	5·40	−0·14

Epoch.	Observer.	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$
		°	°	°	″	″	″
1866·61	Secchi	101·03	100·71	+0·32	5·27	5·38	−0·11
1866·66	O. Struve	100·33	100·65	−0·32	5·29	5·38	−0·09
1867·01	Dembowski	100·97	100·19	+0·78	5·17	5·32	−0·15
1867·41	Main	98·03	99·64	−1·61	5·33	5·26	+0·07
1867·44	Knott	99·73	99·60	+0·13	5·22	5·25	−0·03
1867·52	Talmage	100·43	99·49	+0·94			
1868·46	Dembowski	98·94	98·19	+0·75	4·85	5·10	−0·25
1868·46	Main	97·74	98·19	−0·45	5·27	5·10	+0·17
1868·56	Knott	98·44	98·04	+0·40	4·97	5·08	−0·11
1868·64	Talmage	101·04	97·92	+3·12	5·49	5·07	+0·42
1868·69	Main	101·74	97·85	+3·89	4·96	5·07	−0·11
1868·71	O. Struve	99·04	97·82	+1·22	4·69	5·06	−0·37
1868·72	Dunér	97·44	97·80	−0·36	4·83	5·06	−0·23
1868·90	Brünnow	97·94	97·53	+0·41	4·92	5·03	−0·11
1869·60	Dembowski	96·44	96·48	−0·04	4·71	4·90	−0·19
1869·61	Talmage	100·14	96·46	+3·68	5·31	4·90	+0·41
1869·69	Dunér	96·84	96·34	+0·50	4·58	4·88	−0·30
1870·30	Gledhill	94·65	95·35	−0·70	4·6	4·78	−0·18
1870·45	Main	95·05	95·10	−0·05	4·83	4·75	+0·08
1870·47	,,	94·15	95·07	−0·92	4·80	4·75	+0·05
1870·50	,,	96·35	95·03	+1·32	4·84	4·74	+0·10
1870·51	Dembowski	94·45	95·01	−0·56	4·56	4·74	−0·18
1870·60	Talmage	94·35	94·87	−0·52	4·62	4·72	−0·10
1870·72	Gledhill	93·15	94·64	−1·49	4·3	4·70	−0·40
1870·79	Main	96·55	94·52	+2·03	4·65	4·69	−0·04
1871·48	Wilson & Seabroke	92·75	93·31	−0·56	4·6	4·56	+0·04
1871·49	,,	92·45	93·29	−0·84	4·60	4·56	+0·04
1871·50	Gledhill	92·85	93·27	−0·42	4·4	4·56	−0·16
1871·53	Dembowski	92·55	93·22	−0·67	4·27	4·55	−0·28
1871·55	Talmage	96·65	93·18	+3·47	4·34	4·55	−0·21
1871·59	Knott	94·87	93·11	+1·76	4·30	4·54	−0·24
1871·63	Gledhill	93·05	93·03	+0·02	4·4	4·53	−0·13
1871·72	Dunér	92·55	92·86	−0·31	4·20	4·52	−0·32
1871·80	Gledhill	92·05	91·98	+0·07	4·08	4·50	−0·42
1872·49	Dembowski	90·66	91·39	−0·73	4·08	4·38	−0·30
1872·49	Main	90·76	91·39	−0·63	4·28	4·38	−0·10
1872·49	Ferrari	91·46	91·39	+0·07	4·30	4·38	−0·08
1872·49	Wilson & Seabroke	...	91·39	...	4·61	4·38	+0·23
1872·50	,,	90 66	91·37	−0·71	4·32	4·38	−0·06

Epoch.	Observer.	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$
1872·52	Wilson & Seabroke	91°·86	91°·33	+0°·53	4″·17	4″·38	−0″·21
1872·54	„	91·76	91·29	+0·47	4·07	4·37	−0·30
1872·60	O. Struve	93·56	91·17	+2·39	4·08	4·35	−0·27
1873·41	Main	88·86	89·57	−0·71	4·20	4·15	+0·05
1873·51	Dembowski	88·76	89·37	−0·61	3·89	4·13	−0·24
1873·51	Gledhill	89·46	89·37	+0·09			
1873·51	Wilson & Seabroke	88·76	89·37	−0·61	4·1	4·13	−0·03
1873·55	Talmage	84·66	89·28	(−4·62)	3·95	4·12	−0·17
1873·63	Wilson & Seabroke	88·46	89·09	−0·63	3·93	4·11	−0·18
1873·73	Main	88·66	88·36	+0·30	4·23	4·09	+0·14
1874·47	„	88·67	87·13	+1·54	4·00	3·96	+0·04
1874·56	Dembowski	86·07	86·92	−0·85	3·66	3·94	−0·28
1874·58	Talmage	88·57	86·87	+1·70	3·67	3·94	−0·27
1874·69	O. Struve	87·37	86·59	+0·78	3·78	3·92	−0·14
1874·73	Gledhill	87·47	86·49	+0·98	3·92	3·91	+0·01
1875·52	Dembowski	83·68	84·48	−0·80	3·48	3·77	−0·29
1875·62	Wilson & Seabroke	(95·08)	84·20	(+10·88)	3·49	3·75	−0·26
1875·62	Schiaparelli	84·08	84·20	−0·12	3·44	3·75	−0·31
1875·65	Main	84·78	84·12	+0·66	3·84	3·74	+0·10
1876·52	Doberck	78·88	81·70	−2·82			
1876·54	Plummer	80·18	81·64	−1·46	3·55	3·55	0·0
1876·59	Schiaparelli	81·18	81·48	−0·30	3·34	3·54	−0·20
1876·61	Wilson & Seabroke	80·48	81·42	−0·94			
1876·61	„	80·38	81·42	−1·04	3·37	3·54	−0·17
1876·62	Dunér	81·48	81·39	+0·09	...	3·54	
1877·51	Dembowski	77·58	78·56	−0·98	3·086	3·33	−0·244
1877·51	Flammarion	78·09	78·56	−0·47	3·22	3·33	−0·11
1877·52	Doberck	77·59	78·53	−0·94	3·46	3·33	+0·13
1877·55	Hall	75·81	78·42	−2·61	3·36	3·33	+0·03
1877·58	Jedzrejewicz	79·39	78·31	+1·08	3·180	3·32	−0·14
1877·65	Plummer	78·49	78·01	+0·48	3·39	3·30	+0·09
1877·66	Schiaparelli	77·33	78·01	−0·68	3·121	3·30	−0·179
1877·68	Cin. Obs.	78·49	77·94	+0·55	3·12	3·30	−0·18
1878·51	Dembowski	74·52	74·92	−0·40	2·966	3·13	−0·164
1878·54	Doberck	75·39	74·81	+0·58	3·03	3·12	−0·09
1879·41	Schiaparelli	69·2	71·23	−2·03	2·84	3·11	−0·27
1879·50	„	69·83	70·87	−1·04	2·845	2·92	−0·075
1879·59	Hall	71·32	70·51	+0·81	2·93	2·90	+0·03
1879·64	Schiaparelli	67·9	70·30	−2·40	2·94	2·89	+0·05

Epoch.	Observer.	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$
1879·66	Jedzrejewicz	68·6	70°·22	−1°·62	3″·039	2″·89	+0″·149
1880·49	Franz	62·1	66·33	(−4·23)	2·69	2·72	−0·03
1880·57	Hall	65·5	65·83	−0·33	2·74	2·70	+0·04
1880·66	Schiaparelli	64·88	65·28	−0·40	2·692	2·68	+0·012
1880·66	Jedzrejewicz	62·8	65·28	−2·48	2·75	2·68	+0·07
1881·53	Hall	60·7	59·87	+0·83	2·49	2·51	−0·02
1882·564	,,	56·4	52·80	+3·60	2·31	2·29	+0·02
1882·72	Engelmann	51·63	52·46	+0·83	2·314	2·28	+0·034
1883·49	Perrotin	45·62	46·48	−0·86	2·28	2·15	+0·13
1883·579	Young	43·20	45·75	−2·55	2·45	2·14	+0·31
1883·594	Hall	47·7	45·65	+2·05	2·28	2·14	+0·14
1883·68	Küstner	45·23	44·92	+0·31	2·511	2·11	+0·401
1883·72	Engelmann	43·64	44·61	−0·97	2·25	2·11	+0·14
1884·56	Perrotin	34·54	36·98	−2·44	2·088	2·00	+0·088
1884·588	Hall	37·6	36·71	+0·89	2·16	1·96	+0·20
1884·69	Engelmann	35·28	35·77	−0·49	2·204	1·96	+0·244
1885·566	Hall	29·5	28·24	+1·26	1·87	1·90	−0·03
1885·64	Engelmann	24·32	27·60	−3·28	2·06	1·90	+0·16
1886·528	Hall	13·8	16·64	−2·84	1·98	1·88	+0·10
1886·67	Engelmann	14·90	14·90	0·0	1·88	1·87	+0·01
1887·611	Hall	3·6	4·24	−0·64	1·93	1·83	+0·10
1887·812	Tarrant	3·49	1·97	+1·52	1·91	1·83	+0·08
1887·86	Young	2·50	1·43	+1·07	(2·35)	1·84	(+0·51)

The formulæ for the calculation of an ephemeris are as follows:—

$$u - 28{\cdot}14 \sin u = -4°{\cdot}098\,(t - 1807{\cdot}65)$$

$$\tan \tfrac{1}{2}V = [0{\cdot}2335038] \tan \tfrac{1}{2} u$$

$$\tan (\theta - 120°\ 5') = [9{\cdot}7185017] \tan (V + 171°\ 45')$$

$$\rho = 4''{\cdot}50\,(1 - 0{\cdot}4912 \cos u)\, \frac{\cos (V + 171°\ 45')}{\cos (\theta - 120°\ 5')}.$$

Observations of the Variable Star S (10) Sagittæ By J. E. Gore.

The following are my observations of this short period variable in the year 1887. They form a continuation of the observations given in the *Monthly Notices* for March 1887.

The comparison stars are as before:—

	Mag.
11 Sagittæ	5·8
9 Sagittæ	6·6
DM + 16°, 4086	7·0

Date.	Dublin M.T. h m	Mag.	Date.	Dublin M.T. h m	Mag.
1887, Jan. 11	6 35	5·8	1887, Oct. 27	8 30	6·3
12	6 5	5·7	27	10 30	6·2
Sept. 7	8 20	6·4	29	11 5	5·9
16	7 40	6·4	Nov. 1	10 8	5·7
17	8 15	6·1	13	6 15	6·1
18	7 45	5·75	14	7 30	6·5
18	10 55	5·65	27	7 10	5·8
19	8 20	5·7	Dec. 4	7 10	5·8
22	9 20	6·1	7	6 40	6·2
23	9 15	6·1	9	9 20	6·1
28	11 5	5·75	10	6 45	6·05
29	7 55	5·65	11	7 25	5·7
30	8 55	5·95	13	5 40	5·8
Oct. 8	7 45	6·1	16	7 5	6·3
9	8 20	6·0	17	6 8	6·3
12	9 20	6·2	19	7 15	5·75
21	7 37	5·9	20	5 25	5·65
23	10 15	5·7	21	5 58	5·7
25	7 18	6·0	27	5 35	5·9

A maximum probably occurred during the night of December 20. This corresponds to epoch No. 480, reckoning from an assumed maximum observed by me 1876, December 14.

Introduction to a Catalogue of the Mean Colours of 758 Stars; with Appendix, containing the Colours of 26 Southern Stars. By W. S. Franks.

The Catalogue of Star Colours presented to the Society * differs somewhat from either of its predecessors. The first catalogue, undertaken at the suggestion of the late Rev. T. W. Webb (*Monthly Notices*, June 1878), was intended to give an approximate idea of the colours of all the naked-eye stars visible in these latitudes, as seen with a 5-inch refractor. It contained 3890 stars, the southern limit in Declination being $-25°$. The time occupied—about ten months—in the survey of so many stars was necessarily too short to admit of other than single observations of each object, and the list so made was regarded then more as an experimental opening of a new field than as a work for future reference. In 1884, however, the greater portion

* Deposited in the Library.

of these observations was included (in an abbreviated notation) by Professor Pickering in his "Meridian Photometry," published as vol. xiv. part i. of the *Annals of Harvard College Observatory*. About this time the idea occurred to me that as I had worked for some years exclusively with *reflecting* telescopes, whilst the aforesaid colour estimates were made with a *refractor*, it might be worth while to repeat some of the observations, to ascertain how far the results would be affected by the kind of instrument used. Accordingly the colours of some 1730 of the brighter stars were re-examined, between October 1884 and March 1886, two Newtonian reflectors, of $11\frac{1}{4}$ inches and $5\frac{1}{4}$ inches aperture, being employed for the purpose. The smaller instrument was reserved for circumpolar objects, which were not accessible to the $11\frac{1}{4}$-inch on account of its peculiar mounting. The results arrived at were embodied in the second catalogue, the introduction to which appeared in the *Monthly Notices* for April 1886. The opinion is therein expressed that no appreciable difference exists between the colour results yielded by a reflector and a refractor, but that a great difference of aperture does exert a modifying effect. In both of these catalogues the colours of the stars were given according to the old conventional style, in which the tints of flowers, fruit, and precious stones played a prominent part. But the need for something more definite and systematic than these terrestrial analogies had long been felt, and therefore I attempted the measure of reform described in *Monthly Notices* for March 1887. After subjecting the new system of nomenclature to practical tests by myself and other observers, I determined to make a fresh survey of the colours of some of the brighter stars on this plan, in order to show its adaptability to the required purpose. The selection was guided by Proctor's *Small Star Atlas*, and only such stars retained as were designated by Greek letters; the total number being 758, between the north pole and 25° S. Declination. Three telescopes, all reflectors, were employed in the work, which was begun on December 18, 1886, and completed by October 11, 1887. The apertures and powers used were as follows:—(1) $11\frac{1}{4}$-inch Calver, 80 inches focus; eyepieces 90 and 200 Kellner; the observations with this instrument are entered in *black* ink. (2) $5\frac{1}{4}$-inch Calver, 40 inches focus, eyepieces 45 Kellner and 120 Huyghenian; observations written in *red* ink. (3) $8\frac{1}{2}$-inch With, 63 inches focus, eyepieces 70 and 140 Kellner; observations in *violet* ink. Higher powers were occasionally used in the scrutiny of double stars. Telescopes 1 and 2 passed out of my possession during the progress of the work, the $8\frac{1}{2}$-inch With being exclusively devoted to it from May 8, 1887, to its completion. Finding that I could observe stars much lower than $-25°$, on or near the meridian, I made a working list of some twenty-six that were above 4 mag., and situated in the zone from $-25°$ to $-34°$. These are given in the Appendix. It may be thought that colour observations of such low stars cannot possess any value, on account of the great atmospheric

disturbance which usually prevails near the horizon; and this is undoubtedly true in a general sense. But the experience gained by many thousands of colour estimates had taught me to discriminate somewhat between the inherent hue of a star and its accidental surroundings, otherwise I should not have attempted it. Knowing, also, that no previous observations existed of the colours of most of these objects, I thought that even a crude approximation to their tints was better than absolute ignorance of them, and that the observations so made might possibly be of some service as bearing on the question of atmospheric absorption, when compared with others that may be afterwards made at some southern station.

The catalogue itself needs but little explanation. The work was originally divided into four zones—circumpolar, northern, equatorial, and southern—for convenience in observing, and it has not been thought worth while to disturb this arrangement. The constellations in each zone, as well as the stars in each constellation, being in order of Right Ascension, there can be no difficulty in identifying any object. Column I. gives the name of the star, according to the authority of the B.A.C.; the mark * indicates that it does not appear in the 1884–86 Catalogue, and †* that it is not included in either the 1877–78 or 1884–86 observations. Column II. has the adopted *mean* colour, deduced from the observations in last column but one; columns III. and IV. the R.A. and Declination for epoch 1880 (these are merely approximate, but sufficient for identification); and column V. the photometric magnitude of the star, derived from the Harvard published results. The next column contains the observed colour on three different occasions; and the last column supplies the date of each observation, together with such remarks as are incidental to the object. As to the system of nomenclature used, the coloured chart will give a fair idea of it, though it is not pretended that its execution is artistic, or that the tints themselves are in exact accordance with those of the spectrum on which it is based. The annexed table presents the complete list of symbols, with their equivalents in the ordinary notation. Any further particulars can be ascertained on reference to the paper in the *Monthly Notices* (vol. xlvii. No. 5). The term "bluish purple" (BP) has, however, in the present work been changed to "bluish violet" (BV), as being more in harmony with the general plan of nomenclature.

The Appendix contains the mean colours of twenty-six stars above 4 mag., from $-25°$ to $-34°$, five observations being made of each. Their colours had not, with one or two exceptions, been previously recorded, and the present attempt only professes to be an approximation to their real tints. It is hoped that some southern observer will re-examine them, and give the result of the comparison.

Occultations of Stars during the Total Eclipse of the Moon, 1888, *January* 28, *observed at the Armagh Observatory.* By J. L. E. Dreyer, Ph.D.

I observed the eclipse with the 10-inch refractor, which is erected 120 feet south of the centre of the transit room. Time determinations were made with the mural-circle immediately before and during the eclipse, and the clock in the dome was repeatedly compared with that in the transit room by electric signals. The sky was cloudless but somewhat foggy. A number of stars not given in the following list were watched either at disappearance or reappearance, but the times could not be observed accurately in consequence of the brightness of the limb. For nearly half an hour after the commencement of the total phase the preceding limb of the Moon was still nearly as bright as before totality, and a similar brightness of the following limb occurred before the end of the total phase. About the middle of the eclipse the Moon appeared to the naked eye as a fairly bright disc with a dark isosceles triangle inscribed in it, having the base to the north.

In reducing the observed times to Greenwich Mean Time the longitude $0^h\ 26^m\ 35^s{\cdot}5$ was used. The latitude of the dome is assumed $= 54°\ 21'\ 11''{\cdot}5$; it is 210 feet above mean sea level.

Star's No.	Phenom.	Loc. Sid. T. h m s	G.M.T. h m s	Remarks.
164	Disapp.	6 36 14·3	10 32 19·4	Fair.
165	Disapp.	6 37 18·7	10 33 23·6	* very faint.
198	Disapp.	7 13 30·9	11 9 29·9	Fair.
209	Disapp.	7 24 6·0	11 20 3·2	Difficult.
210	Disapp.	7 24 57·0	11 20 54·0	—
201	Disapp.	7 28 24·3	11 24 20·8	Good.
164	Reapp.	7 49 9·2	11 45 2·3	Good.
236	Disapp.	7 56 2·0	11 51 54·0	* very faint.
201	Reapp.	8 8 47·1	12 4 37·0	—

The Total Lunar Eclipse of 1888, *January* 28, *observed at the Dunsink Observatory.* By A. A. Rambaut.

(*Communicated by Sir R. S. Ball.*)

On the night of January 28 this observatory was specially favoured in point of weather. Although during the afternoon the clouds looked very threatening, shortly after the Moon rose the sky cleared, and remained perfectly unclouded for the rest of the night.

The instrument employed was the "South" equatorial of $11\frac{3}{4}$ inches aperture, carrying a power of 177, and the dome was

connected with the chronograph described in the Sixth Part of our publications, which has just been distributed, and which contains a copy of one of our chronograph sheets.

It is, of course, very much more difficult to determine the instant at which an occultation occurs than the time of transit across a wire when it is estimated with the eye and ear from a clock or chronometer, especially if the phenomenon takes place sooner than expected, but with the chronograph this difficulty, I believe, almost wholly disappears.

In observing a transit with the meridian circle it is my habit (I do not know what that of others may be) to make no motion until the star appears exactly bisected by the wire; that is to say, I do not attempt to make the signal and the transit exactly simultaneous, though it might be possible to do so when the star is in view the whole time. There is thus a constant difference between the time of transit and that at which the signal is sent, which in the determination of star places is of course eliminated.

In the case of an occultation the signal must be sent a little too late by an amount depending on the personal equation of the observer. But I believe that in my case the two signals are directly comparable, and I should be inclined to give as much weight to the time of a good observation in the list which is given below, as to the time of transit at a single wire.

The list which we received from Professor Otto Struve contained 73 occultations—disappearances and reappearances—but as the intervals between some of them appeared too short, the number was reduced to 63 before the date of the eclipse. I took the precaution of checking all Professor Struve's results by means of the formulæ given in his circular and the figures he sent us along with the list.

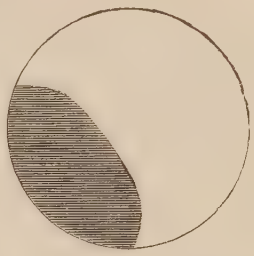
In the case of 141 the corrections, amounting to $0^{m}\cdot7$ and $0^{m}\cdot4$ respectively, were of great use, especially at its reappearance, since without it the occurrence might easily have been missed.

No trace of the penumbra was noticeable to the naked eye before $9^{h}\ 10^{m}$ G.M.T., but on looking through the telescope at that hour it was observed that more than half the disc was slightly obscured. By $9^{h}\ 23^{m}$ the whole surface had become more or less shaded, and appeared of a dull sandy colour, except the western limb, which was still of a silvery hue.

At $9^{h}\ 31^{m}$ the first trace of the shadow was noticed. At about $9^{h}\ 35^{m}$ the limb assumed the colour of copper, whereas the edge of the shadow appeared almost black. Aristarchus, which was then in the shadow, appeared considerably brighter than the surrounding region.

At $9^{h}\ 55^{m}$ the obscured portion became visible to the naked eye, the limb appearing less shaded than the edge of the shadow, the disc having almost the effect of being bounded by a bright line. At this hour, when the magnitude of the eclipse was about 0·4, the shadow appeared to the naked eye somewhat the shape

shown in the diagram, but the telescope showed no trace of irregularity in outline.



The following is a list of the occultations observed during the total phase of the eclipse :—

Occultations of Stars observed during the Total Lunar Eclipse of 1888, *January* 28.

"South" refractor of $11\frac{3}{4}$ inches. Power, 177.

Star.	Dunsink Sidereal Time. Disappearance.	Reappearance.	Greenwich Mean Time. Disappearance.	Reappearance
	h m s	h m s	h m s	h m s
153	6 31 41·64	7 39 13·37	10 26 33·3	11 33 53·9
157	6 34 37·38	7 28 47·61	10 29 28·5	11 23 29·9
164	6 37 22·55	7 50 37·75	10 32 13·2	11 45 16·5
166	6 37 31·78	7 47 51·35	10 32 22·5	11 42 30·5
165	6 38 34·98	7 51 11·23	10 33 25·5	11 45 49·8
141	6 44 54·19	7 9 6·35	10 39 43·7	11 3 51·9
136	—	6 49 14·67	—	10 44 3·4
180	6 50 32·58	7 59 49·05	10 45 21·1	11 54 26·2
172	6 53 28·17	7 52 21·14	10 48 16·2	11 46 59·6
181	7 1 30·85	7 53 14·96	10 56 17·6	11 47 53·2
128	—	7 3 21·18	—	10 58 7·6
198	7 14 34·85	—	11 9 19·5	—
194	7 18 31·05	8 4 34·11	11 13 15·0	11 59 10·5
142	—	7 22 0·36	—	11 16 43·8
148	—	7 24 59·85	—	11 19 42·8
190	7 27 0·63	8 9 23·47	11 21 43·2	12 3 59·1
155	—	7 32 39·04	—	11 27 20·7
150	—	7 35 34·65	—	11 30 15·8
216	7 40 33·32	—	11 35 13·7	—
225	7 42 48·92	—	11 37 28·9	—
224	7 43 51·24	—	11 38 31·1	—
236	7 56 36·03	—	11 51 13·8	—
201	—	6·22	—	12 7 41·2
247	8 15 30·04	—	12 10 4·7	—

Remarks.

	Disappearance.	Reappearance.
153	—	Good.
157	Very well seen.	Good.
164	Good.	Good.
166	Good.	Good.
165	Good.	Good.
141	Very bad; limb still very bright.	Perhaps half a second late.
136	—	Perhaps a quarter of a second late.
180	Beautiful.	Subtract half a second.
172	Difficult.	—
181	Good.	Perhaps a few tenths of a second late.
128	—	Fair.
198	Beautiful. Instantaneous.	—
194	Good.	Good.
142	—	Fair.
148	—	Excellent.
190	Seemed to be extinguished momentarily several seconds before final disappearance.	Good.
155	—	Clear of limb when first seen and signal sent. Very faint. Observation almost worthless.
150	—	Good.
216	Limb brightening.	—
224	Difficult owing to brightening of limb.	—
236	Projected on the disc a few seconds before final disappearance.	—
201	—	Good, although limb very bright.
247	Appeared in contact with limb 2^s before final disappearance.	—

At $11^h\ 6^m\ 25^s$ a meteor crossed the disc of the Moon slightly to the south of Plato, the position-angle of its path being about 250°.

The end of the total phase occurred between the times given for the occultations of 201 and 247. I find in my note-book opposite No. 201, "Bright limb reappears," and opposite No. 247 "Totality distinctly over." The mean of the two would give $12^h\ 9^m$.

As the shadow passed off the Moon nothing of importance was noticed. No irregularity was observed in the outline of the shadow which might not be accounted for by the colour of the surface where it fell. Where the edge crossed the grey plains, the darkening of the surface in immediate proximity to the edge of the shadow had the effect of making the latter appear to project a little beyond the regular curve which bounded it, but as the shadow passed on the protuberance disappeared, or reappeared in another place, according to the nature of the surface where it happened to fall. This effect was most noticeable when the shadow crossed the Mare Serenitatis and the Mare Tranquillitatis.

The last contact with the shadow took place at $13^h\ 10^m$.

These times, though of course liable to error on account of the diffused edge of the shadow, are at least free from bias. I was observing with a chronometer which recorded sidereal time, and I had no idea of the correction necessary to reduce it to G.M.T. I therefore give the figures for what they are worth.

Dunsink: 1888, *February* 3.

Observations of Stars made at the Glasgow Observatory in connection with the Total Eclipse of the Moon of 1888, *January* 28.

(*Communicated by Professor R. Grant, F.R.S.*)

The eclipse was observed under favourable circumstances as regards the weather. The observations of disappearance and reappearance were made with the 9-inch equatorial. The observer was Mr. John McKinnell.

No. of Star.	Mag.	Disappearance. G.M.T.	Reappearance. G.M.T.
		h m s	h m s
153	10	10 28 49·25	...
164	8	10 35 56·99	11 48 7·64
165	9·5	10 36 49·75	...
180	9·5	10 51 12·32	11 54 51·05
126	9·5	...	10 59 45·89
148	10	...	11 19 30·64
157	9 5	...	11 21 15·14
201	8·5	11 33 44·81	12 1 10·90
225	10	11 40 35·48	...
166	9·5	...	11 43 25·15

The Moon during total obscuration presented a copper-coloured aspect the hue of which was more pronounced towards the limbs.

The Observatory, Glasgow:
1888, *March* 7.

Occultations of Stars observed at Liverpool Observatory, Bidston, Birkenhead, during the Total Eclipse of the Moon, 1888, *January* 28. By John Hartnup.

The following observations were made with the equatorial, which is provided with an object-glass by Merz, of 8·5 inches aperture. Passing clouds prevented the observation of some of the stars, but the chief difficulty was the brightness of the Moon

when totally eclipsed. This was so great that with the means at my disposal I found it impossible to observe the occultations of the fainter stars in the Pulkowa list.

The instants of disappearance and reappearance were recorded by means of a Bond's spring-governor chronograph, which records automatically every two seconds the time shown by the sidereal standard. The error of the latter was determined on the same evening by a series of transit observations recorded in a similar manner.

As seen from this observatory the total eclipse of the Moon of 1884, October 4, was much darker than that of 1888, January 28.

No. in Pulkowa List.	Mag.	Phenomenon.	Time by Sidereal Standard.	Local Sidereal Time.	Greenwich Mean Time of Observation.	
			h m s	h m s	h m s	
153	10	Disappearance	6 49 1·2	6 49 51·97	10 31 38·83	(*a*)
157	9·4	,,	6 53 8·0	6 53 58·77	10 35 44·95	
164	8·0	,,	6 53 35·8	6 54 26·57	10 36 12·67	
166	9·5	,,	6 53 46·7	6 54 37·47	10 36 23·55	
165	9·4	,,	6 54 49·2	6 55 39·97	10 37 25·87	
180	9·5	,,	7 6 55·4	7 7 46·18	10 49 30·10	(*b*)
190?	11	,,	7 42 23·4	7 43 14·19	11 24 52·30	(*c*)
157	9·4	Reappearance	7 44 36·8	7 45 27·59	11 27 5·34	
166	9·5	,,	8 4 23·6	8 5 14·40	11 46 48·91	
164	8·0	,,	8 7 30·4	8 8 21·20	11 49 55·20	
165	9·4	,,	8 8 4·0	8 8 54·80	11 50 28·70	(*d*)

Notes.

(*a*) Star faint. (*b*) Disappeared at $7^h\ 6^m\ 49^s{\cdot}6$, but reappeared about two seconds later, and finally disappeared at $55^s{\cdot}4$. (*c*) Star very faint; observation doubtful. (*d*) About one second late.

Power used, 90. The longitude $12^m\ 17^s{\cdot}15$ W. has been used in converting Bidston mean solar time into Greenwich mean solar time.

Observations of Occultations of Stars made at the Radcliffe Observatory, Oxford, during the Total Lunar Eclipse of 1888, *January* 28.

(*Communicated by E. J. Stone, M.A., F.R.S., Radcliffe Observer.*)

The following occultations were observed under rather unfavourable atmospheric circumstances, the sky becoming hazy and cloudy.

No. in Pulkowa List.	Mag. from List.	Phenom.	Time noted. h m s	G.M.T. of Observation. h m s	Observer.	Ref. to Notes.
...	(10)	Disapp.	6 41 21·2	10 15 50·3	W.	(*a*)
148	10	,,	6 47 11·3	10 21 39·4	W.	(*b*)
157	9·4	,,	6 57 53·8	10 32 20·2	W.	
		,,	6 58 42·	20·5	R.	(*c*)
		,,	10 32 41·	18·4	F. B.	
164	8·0	,,	7 3 44·3	10 38 9·7	W.	
		,,	7 4 32·2	9·7	R.	(*d*)
		,,	10 38 31·8	9·2	F. B.	
165	9·4	,,	7 6 (0·)	10 39 (37·)	R.	(*e*)
		,,	10 39 33·	10 39 10·4	F. B.	
180	9·5	,,	7 15 55·8	10 50 19·2	W.	
		,,	7 16 44·0	19·5	R.	(*f*)
		,,	10 50 42·3	19·6	F. B.	(*g*)
126	9·5	Reapp.	7 27 33·5	11 1 55·0	W.	
		,,	7 28 16·5	50·1	R.	(*h*)
		,,	11 2 12·5	49·8	F. B.	(*i*)
201	8·7	Disapp.	7 51 46·	11 26 3·6	W.	(*j*)
		,,	7 52 33·	2·7	R.	(*k*)
		,,	11 26 23·8	1·1	F. B.	(*l*)
157	9·4	Reapp.	11 32 45·	11 32 22·2	F. B.	(*m*)

Observer.		Aperture. in.	Power used.
W.	Mr. W. Wickham, Barclay Equatorial .	10	85
R.	,, W. H. Robinson, Heliometer . .	7·5	80
F. B.	,, F. A. Bellamy, 10-foot Telescope .	7	90

Notes.

(*a*) and (*b*) Faint, cloudy. Both stars about the same angle and magnitude. (*c*) Doubtful to 2^s. Faded gradually. (*d*), (*f*), (*g*), and (*i*) Good observations. (*e*) Exceedingly faint. Observation very doubtful. May be 10· in error. Cloudy. (*h*) Fairly good. Reappeared instantaneously. At $11^h\ 1^m\ 30^s \pm$ a meteor of about the 7th star magnitude flashed across Moon from 225° (± 5°) through 75° (± 20°) from North Point. (*i*) Whilst watching for reappearance, saw the meteor referred to by Mr. Robinson. (*j*) A slow disappearance. (*k*) Faint; difficult. (*l*) and (*m*) Hazy cloud.

Radcliffe Observatory, Oxford:
1888, *January* 30.

Observations of Stars Occulted by the Moon during the Eclipse of 1888, January 28, at the University Observatory, Oxford. Made under the direction of Professor C. Pritchard, D.D., F.R.S.

All due preparations were made for observing the occultations; but the state of the sky was so fitful, and in general so hazy, that very few phenomena could be observed at all, and of those that were attempted probably none is of any value—not even excepting No. 164, where the times of disappearance recorded by the two observers are identical, and the reappearance of No. 136, where the recorded times are fairly close.

Four photographs of the Moon, taken with a 15-inch mirror, were secured before totality, but they possessed the same abortive characteristics as those presented by the star occultations, and from the same causes.

The intention was to photograph the district containing the occultable stars, but up to the present time the sky has presented no favourable opportunity.

Phase	Immersion.		Emersion.	
Instrument	Grubb Refr.	De la Rue Refl.	Grubb Refr.	De la Rue Refl.
Aperture	12½ inches.	13 inches.	12½ inches.	13 inches.
Power	120	80	120	80
Observer	Jenkins	Plummer	Jenkins	Plummer
G.M.T.	h m s	h m s	h m s	h m s
No. 157*	10 31 48·3			
164	10 38 9·1	10 38 9·1		
180	...	10 50 20·5		
136	...	...	10 56 1·2	10 55 59·9
126	...	...	11 1 53·4	11 1 55·4
128	...	...	...	11 4 53·7
*	11 13 58·9			
198	...	11 15 39·6		
201	11 26 2·4	11 26 3·5		

University Observatory, Oxford:
1888, March 8.

* Numbers as given in Dr. Döllen's list, dated Pulkova, Dec. 18, 1887.

Total Eclipse of the Moon, 1888, *January* 28.
By the Rev. S. J. Perry, D.Sc., F.R.S.

The long duration of this eclipse, and the pains taken by Professor Döllen in calculating the positions of the stars to be occulted at Stonyhurst during totality, made me give special attention to the preliminary observations for this eclipse. Some of the star places were recalculated by the Rev. W. Crofton, as Professor Struve in his circular to the observatories had requested that this should be done for greater security, and the results proved that the graphical method adopted by Professor Döllen was sufficiently accurate. A careful map was also drawn of all the stars to be occulted, and this was compared with the charts of Chacornac and Argelander in order to identify as many stars as possible beforehand. A $5\frac{1}{2}$-inch achromatic of Alvan Clark, which gives most perfect definition, was set apart for the occultations, and was supplemented by a 4-inch equatorial of Jones. The 8-inch instrument of Simms was reserved for a spectroscopic examination of the light of the eclipsed Moon, and the spectroscope used on this equatorial was so constructed by Hilger that one or two prisms of 30° can be used at will, six sets of prisms of aluminium, quartz, calcite, dense flint, white flint, and crown glass being adapted to the same mounting. A series of observations was made with the different prisms during the week that preceded the eclipse, measurements of the lines in the spectrum of the clouds and also of the lunar crescent were taken, and the spectroscope was found to work very satisfactorily. Two aluminium prisms gave altogether the best results, as the lunar spectrum was strong, and the fine lines distinct throughout. A single prism of aluminium glass, or of white flint, gave equally good definition, though the lines were somewhat clearer in the violet with the aluminium, and in the rest of the spectrum with the flint. The calcite was at least as good as either of the other prisms in the red, and was fair in the violet, but much inferior in the remainder of the spectrum. The dense flint and crown gave the lines less distinctly; but with one, or with two, quartz prisms the details were seen almost as well as with the aluminium. I am dwelling rather longer on these preliminary observations than might perhaps be deemed necessary, but I am doing so advisedly, as the trustworthiness of the results obtained during the eclipse must depend mainly on the fitness of the spectroscope for the object proposed.

Early on the evening of the eclipse the sky was all that could be desired, and the penumbra was very visible on the Moon at $8^h\ 48^m$. A series of readings of the principal lines in the lunar spectrum was then taken, the two aluminium prisms being used, and giving a very extended spectrum. During these measures cirrus clouds were thickening, and a brilliant double halo formed round the Moon two orange rings, of about 12° and 16° in

diameter, enclosing a space of a greenish-blue tint. At $9^h\,25^m$ the penumbra at the eastern limb had become very dark, and at $9^h\,29^m$ the shadow gave the limb the appearance of being flattened, which was probably the effect of the first contact of the umbra. At $10^h\,5^m$ nearly the whole of the limb of the partially eclipsed Moon, and also great part of the shaded surface, was clearly visible in spite of cirrus clouds. The outline of the umbra was not very regular, a long depression appearing near the centre with a considerable elevation north of the centre, and a less striking one near the south point. At $10^h\,12^m$ the eclipsed portion of the Moon was becoming more distinct, its colour being a brick red, but almost orange in the brighter parts. Five minutes before totality thin clouds were still around the Moon. The beginning of totality was noted at $10^h\,30^m\,21^s{\cdot}9$ G.M.T. About five minutes after totality commenced the stars were shining brightly in every direction, and the fainter ones were visible in the telescope, showing that the clouds had entirely disappeared. A curious wedge-shaped and very dark shade was observed on the lunar surface, and its form cannot be accounted for by any of the known features of the Moon.

The eclipsed Moon, which was very distinct, although its general appearance was that of a bright object seen through a fog, was being kept by the driving clock on the slit of the spectroscope, lest any uncertainty as to its exact position might arise—a precaution not always unnecessary in previous eclipses. The viewing telescope of the spectroscope had been most carefully focussed on the green part of the spectrum, with the pointer of the micrometer fixed on the line corresponding to 1474 K. I chose this position because I thought that, if any bright lines from the outer corona were reflected by the lunar surface, this well known coronal line would be the most conspicuous. Nothing was altered, no screw touched, and I felt sure that the two aluminium prisms were under the best conditions for showing the true spectrum of the eclipsed Moon. I scarcely expected to see so much light through the spectroscope with so narrow a slit, but I looked in vain for any sign of bright or dark lines, and my assistant, Mr. W. McKeon, whose eye is exceedingly well trained, was equally unsuccessful in detecting lines. The spectrum, extending from the red to somewhat beyond F, was of a rather indistinct yellowish green throughout. A wider slit increased the amount of light, and showed the red end of the spectrum fairly well, but the violet was completely cut off, as well as most of the blue. No appearance of lines, or even of increased intensity of light, at any point of the spectrum could be noted.

At $10^h\,40^m\,17^s$ the west limb to a considerable width was much brighter than the rest of the surface, and interfered very much with the faint stars whose occultations were being observed through the $5\frac{1}{2}$ and 4-inch achromatics.

The triangular, or wedge-shaped, patch of shadow had now become much darker than the remainder of the surface; but at $10^h\,54^m\,30^s$ this dark patch was already more diffused.

One prism of aluminium glass, and then one of quartz, and lastly one of white flint, were now tried in the spectroscope, but with no other result than that obtained with the two prisms of aluminium; although the quartz gave a larger quantity of light, especially at the red end of the spectrum, whilst with the flint prism the red was scarcely visible. As we had not the advantage of focussing on the bright Moon before each of these changes, the observation with the two prisms of aluminium can alone be considered perfectly satisfactory, although the observations with the single prisms afford some confirmation of the previous result. The spectrum of the eclipsed Moon was, I think, quite bright enough to have shown dark lines had the ordinary solar lines been present; and I hardly imagine that the diminution of light, in passing from the spectrum of the bright to that of the eclipsed Moon, was sufficient to account for the total absence of so much of the blue end of the spectrum. I hope on July 22 of this year again to examine the spectrum of the eclipsed Moon with the same instrument, but substituting quartz lenses, in place of ordinary achromatics, for the collimator and viewing telescope; and then with quartz prisms the violet end, if not greatly absorbed, will scarcely escape detection.

At $11^h\ 10^m$ the surface of the Moon was throughout of a more uniform tint, the seas, however, being of a somewhat darker red than the other portions; the only exceptional feature was a not very conspicuous brightening of the southern limb. The irregular dark patch mentioned above had entirely vanished. At $11^h\ 27^m$ the illumination of the limb was passing round to the eastern side. At midnight the Moon's edge was rapidly brightening, and at $12^h\ 7^m\ 13^s$ the end of totality was noted. Two small bright projections, about 8° apart on the limb, were very striking in the 4-inch finder; they were near the point of reappearance.

The following is a list of the observed occultations, the stars being numbered according to the printed list sent by Professor O. Struve to the observatories of Europe.

Star.	Greenwich Mean Time. Disappearance.	Greenwich Mean Time. Reappearance.	Diam. of O.G.	Power.	Observer.	Remarks.
	h m s	h m s				
157	10 35 8·1	—	$5\frac{1}{2}$	46	W. J. C.	Passing clouds.
164	10 37 6·5	11 50 44·1	4	44	A. C.	
,,	10 37 6·7	11 50 44·1	$5\frac{1}{2}$	46	W. J. C.	
136	—	10 46 9·7	,,	,,	,,	
180	10 50 51·3	—	,,	,,	,,	
,,	—	11 59 2·6	,,	,,	W. C.	
126	—	11 1 33·8	,,	,,	W. J. C.	
209	11 25 48·4	—	,,	,,	W. C.	Very faint.
201	11 29 16·1	12 10 14·4	4	44	A. C.	
,,	11 29 16·4	12 10 14·2	$5\frac{1}{2}$	46	W. C.	
166	—	11 47 19·1	,,	,,	,,	
165	—	11 51 29·8	,,	,,	,,	
236	11 55 40·4	—	8	43·5	S. J. P.	Last seen.

The initials W. J. C., A. C., W. C., and S. J. P., are those of the observers William Crofton, Aloysius Cortie, William Carlisle, and Stephen Joseph Perry.

Stonyhurst Observatory:
1888, *February* 16.

Occultations observed at Harrow during the Total Eclipse of the Moon, 1888, *January* 28. By G. L. Tupman.

Every precaution was taken to ensure success on this occasion, but fleecy clouds and haze and the unexpected brightness of the Moon rendered the smaller stars quite invisible.

General Tennant very kindly came over and observed with the 18-inch mirror, using the chronograph to register the times. He says:—

"Very soon after totality commenced the sky near the Moon was clouded, and from that time, although the Moon's limb was generally visible, stars were rarely so. From what was seen, it was evident that the Moon was very bright and white in colour, even on the limb near the centre of the shadow (the other limb was much brighter), and that the smaller stars could not have been seen in contact with the limb. Indeed, at the disappearance of No. 166 and No. 164 each was thought to be gone some 3^s before the times noted, but a re-examination showed that they were still on the limb though hardly distinguishable."

I looked at the Moon for a minute or two, with the large reflector, half an hour after the commencement of totality. Not a star was to be seen near it. I do not agree with General Tennant that the Moon was white; to me it was very red, although less red in the telescope than with the unaided eye.

The following are the times as read from the chronograph fillet; they should be diminished $0^s.3$ or $0^s.4$:—

Star.	Clock.	Local Sidereal Time.	Greenwich Mean Time.
	h m s	h m s	h m s
157	Im. 7 3 17·2	7 2 26·65	10 33 15·9
166	Im. 7 8 18·5	7 7 27·95	10 38 16·4
164	Im. 7 9 25·2	7 8 34·65	10 39 22·9
164	Em. 8 24 0·0	8 23 9·45	11 53 45·5
180	Em. 8 34 23·3	8 33 32·75	12 3 7·1*

* This was seen as a bright speck on the limb at this moment; but the limb was only seen clearly for a few seconds, and before the observation could be verified it was dulled by the mist.—J. F. T.

I observed for local time the same evening with the meridian circle :—

	Clock Correction.
	s
5 Ursæ Min., S.P. (one wire only)	−50·25
δ Ceti	−50·52
θ Persei	−50·41
δ Geminorum	−50·60
	s
Daily rate of clock	−0·58

The coordinates of the observatory are : Lat. 51° 34′ 47″·4 N.; Long. (W. of Greenwich) $1^m\ 19^s{\cdot}85$; height above mean sea level, 220 feet.

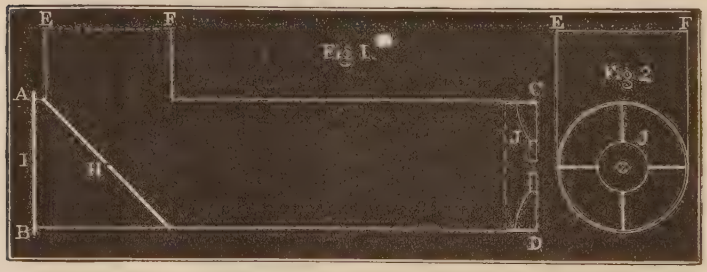
Note by General Tennant.—The peculiarity (for I seem to have been singular) in my estimation of the colour of the Moon during eclipse is probably due to the eye. In vol. xxix. p. 106, of the *Notices*, will be found a note that red stars did not produce on my eye the impression of marked colour. This especially refers to the right eye used in these observations.

An Improved Centering Tube for Reflecting Telescopes.

By Edward Crossley, M.P.

In the *Monthly Notices* for March 1887 I gave a description of a new centering tube for reflecting telescopes. I have since much improved its construction so as to make it more easily used and more accurate.

It consists of a tube A B C D, figs. 1, 2, 10 inches long, $2\frac{5}{8}$ inches in diameter, with an open elbow E F. Opposite this elbow is placed a plane reflector, A G, perforated at H. A surface of bright tin answers well. In the centre at A B is the pin hole I. At C D is placed a perforated disc, J, 1 inch in diameter, with $\frac{1}{4}$-inch hole, attached to a rim by four arms placed edgewise; the rim slides into the tube. It is used in the following manner :—



The tube is placed in the eyepiece end or holder of the telescope, to which it is a nice fit; and looking through I H and the

whole aperture C D without removing J, the eye end is adjusted so that the flat appears central. A disc of white paper half the diameter of the tube is gummed to the centre of the face of the large mirror. The flat is then adjusted so as to show the disc by reflection central in the aperture of J.

These operations can be performed by daylight. The disc is most easily seen by side light down the tube.

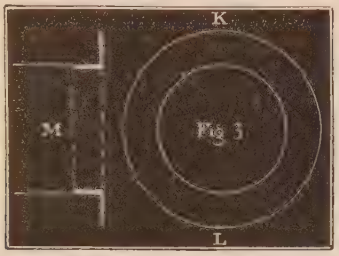


Fig 3.

In order that the last operation can also be performed by daylight a ring cap or collar, K L of section M, is placed in the tube at C D, and the plane annular face of this collar towards the flat is painted white.

The daylight which illuminates the disc on the large mirror will also illuminate the white ring, and the large mirror can now be adjusted so that the white ring shall appear by reflection exactly central with the disc. The adjustment of the telescope is now complete.

The whole of these adjustments can also be made in the same order by holding a bull's-eye lantern with the lens in the elbow E F. The elbow shields the eye from the light. The mirror A G throws ample light through the aperture C D without removing J, so that an image of the aperture is reflected back by the large mirror and the flat so as to appear like a halo surrounding the disc (like an annular eclipse of the sun) in the centre of the aperture J, when the flat and the large mirror have been adjusted in the same order as before.

The advantages of this centering tube are that it can be used night or day in any position of the telescope by simply putting it in place of the eyepiece, and accurate centering is at once obtained.

Telegraphic Determination of the Longitude of Haiphong.

By Dr. W. Doberck.

(*Communicated by the Astronomer Royal.*)

The determination of the longitude of Haiphong was undertaken at the proposal of M. La Porte, Chef de la Mission Hydrographique du Tonkin, and effected through the cable of the Eastern Extension, Australasia and China Telegraph Company, which was placed at our disposal for a short time on three consecutive evenings at the request of the Résident-Général du Tonkin. The telegraphists at both stations assisted us with the great courtesy always experienced from that Company in matters of public interest by scientific men in different parts of the world. Unfortunately, owing to the approaching departure from Haiphong of M. La Porte, there was not much time to make detailed arrangements beforehand.

Signals were exchanged on the 5th, 6th, and 7th April, 1887. The weather was clear at both stations, and transit observations of a sufficient number of stars were obtained each night both in Haiphong and in Hongkong. The small observatory in Haiphong is placed beside the Post Office "à 310 m. dans l'ouest du point marqué Pagode de l'Observatoire sur le plan français 3506 (Plan des Environs de Haiphong et de Quang-Yen)." The masonry pier on which the transit instrument is placed was constructed more than a year ago. The transits were observed by M. La Porte with a sidereal chronometer, which was, on the two first nights, carried down to the telegraph office for use in exchanging signals, being compared before and after this transport with a chronometer that remained in the observatory. On the last night the sidereal chronometer remained in the observatory, and was compared with a mean-time chronometer by aid of which the signals were exchanged.

The observations in Hongkong were made with the transit instrument and the sidereal standard clock. Mr. F. G. Figg made the observations and comparisons on the 6th, and I myself observed and compared on the 5th and 7th. The standard clock was compared with two mean-time chronometers which were carried across the harbour in a steam launch. After our return the chronometers were again compared. Inter-comparisons in the telegraph office proved the regularity of their rate in the meantime. They were used alternately in the exchange of the signals.

The signals were made and observed as follows:—The attention of the observer at the other station was called by a number of taps, and half a minute later eight or nine signals were given at every ten seconds on the chronometer by depressing the key. After changing the observer and chronometer in Hongkong attention was again called and another series sent. The signals

consisted in deflections of the ink-writer on Sir W. Thomson's Patent Siphon Recorder, and were observed by eye and ear with the chronometers by M. La Porte, in Haiphong, or by the two observers in Hongkong. Subsequently the Haiphong and Hongkong Mean Times of the mean of each series of signals were obtained as explained above, and they are exhibited in the following table.

1887, *April* 5.

From	To	Observer.	H. K. M.T.	Hph. M.T.	Difference.	Longitude.
		H.K. Hph.	h m s	h m s	m s	m s
H. K.	Hph.	D. P.	8 47 14·27	8 17 16·66	29 57·61	29 57·95
,,	,,	F. ,,	8 49 21·70	8 19 24·08	57·62	57·96
Hph.	H. K.	D. ,,	8 53 45·48	8 23 47·10	58·38	58·04
,,	,,	F. ,,	8 53 45·67	,,	58·57	58·23
,,	,,	,, ,,	9 0 14·24	8 30 15·99	58·25	57·91
,,	,,	D. ,,	9 0 14·24	,,	58·25	57·91
,,	,,	F. ,,	9 4 23·50	8 34 25·32	58·18	57·84
,,	,,	D. ,,	9 4 23·65	,,	58·33	57·99
,,	,,	F. ,,	9 11 12·40	8 41 14·18	58·22	57·88
,,	,,	D. ,,	9 11 12·43	,,	58·25	57·91
H. K.	Hph.	,, ,,	9 14 51·70	8 44 53·98	57·72	58·06
,,	,,	F. ,,	9 18 54·44	8 48 56·88	57·56	57·90

1887, *April* 6.

H. K.	Hph.	D. ,,	8 44 20·84	8 14 23·36	57·48	57·71
,,	,,	F. ,,	8 46 20·64	8 16 23·14	57·50	57·72
Hph.	H. K.	D. ,,	8 55 1·76	8 25 3·82	57·94	57·72
,,	,,	F. ,,	8 55 1·84	,,	58·02	57·79
,,	,,	D. ,,	8 56 31·43	8 26 33·58	57·85	57 62
,,	,,	F. ,,	8 56 31·53	,,	57·95	57·73

1887, *April* 7.

H. K.	Hph.	D. ,,	8 32 7·53	8 2 10·15	57·38	57·66
,,	,,	F. ,,	8 40 0·14	8 10 2·57	57·57	57·85
,,	,,	D. ,,	8 43 41·14	8 13 43·62	57·52	57·80
,,	,,	F. ,,	8 44 37·56	8 14 40·05	57·51	57·79
Hph.	H. K.	D. ,,	8 48 19·56	8 18 21·63	57·93	57·65
,,	,,	F. ,,	8 48 19·68	,,	58·05	57·77
,,	,,	D. ,,	8 50 19·65	8 20 21·62	58·03	57·75
,,	,,	F. ,,	8 50 19·85	,,	58·23	57·95

Taking the mean of the differences of time obtained by sending the current in either direction, and then subtracting the smaller from the greater, and dividing by two the amount of retardation due to induction owing to the electro-static capacity of the cable—which is all underground or under water, being insulated by gutta-percha, and 498·6 miles in length—we obtain the retardation. It was on the three nights respectively :—$0^s{\cdot}34$, $0^s{\cdot}225$, and $0^s{\cdot}28$, or on an average $0^s{\cdot}282$. After correcting the observed differences of time for retardation, the different values of the observed longitude of Haiphong west of Hongkong, exhibited above, were obtained.

The means of the results obtained by M. La Porte in Haiphong and the two observers in Hongkong are as follows :—

	Observers.		
	P. and D.	P. and F.	Mean.
	m s	m s	m s
1887, April 5	29 57·977	29 57·953	29 57·965
„ 6	·683	·747	·715
„ 7	·715	·840	·778
Mean	29 57·792	29 57·847	29 57·819

The longitude of the transit instrument in the Hongkong Observatory is, according to observations made in 1881 by Lieut.-Commander Green, U.S.N., who connected Hongkong with both Madras and Wladiwostock :—$7^h\ 36^m\ 41^s{\cdot}86$ east of the meridian of the Royal Observatory, Greenwich, therefore the longitude of the transit instrument in Haiphong is :—

$7^h\ 6^m\ 44^s{\cdot}04$ east of Greenwich.

The probable error of the longitude of Hongkong does not appear to be much more than a tenth of a second, and the probable error of the difference being about a twentieth of a second, it follows that the probable error of the longitude of Haiphong is below a fifth of a second.

Hongkong Observatory:
1887, *December* 23.

Ephemeris for Physical Observations of the Moon for the Nine Lunations from April 12 to the end of 1888. By A. Marth.

Greenwich Noon.		Selenographical Colong. of the Sun.	Lat. of the Sun.	Geocentric Libration. Long. of the Earth.	Lat. of the Earth.	Amount.	Direction.
1888.		°	°	°	°	°	°
April	12	282·50	−1·48	−0·24	+6·54	6·54	2·1
	13	294·72	1·49	1·52	6·42	6·60	13·3
	14	306·95	1·50	2·81	6·02	6·64	24·9
	15	319·17	−1·50	−4·07	+5·36	6·73	37·1
	16	331·38	1·51	5·26	4·46	6·90	49·6
	17	343·59	1·52	6·33	3·35	7·15	62·0
	18	355·80	1·52	7·19	2·06	7·48	74·0
	19	8·00	1·53	7·77	+0·64	7·80	85·3
	20	20·20	1·53	7·99	−0·85	8·03	96·1
	21	32·39	1·54	7·76	2·35	8·11	106·9
	22	44·57	−1·54	−7·04	−3·75	7·98	118·2
	23	56·75	1·55	5·81	4·97	7·65	130·7
	24	68·93	1·55	4·12	5·90	7·19	145·2
	25	81·20	1·55	−2·09	6·43	6·76	162·1
	26	93·27	1·55	+0·12	6·51	6·51	181·1
	27	105·44	1·55	2·29	6·13	6·54	200·5
	28	117·61	1·54	4·23	5·31	6·79	218·4
	29	129·79	−1·54	+5·79	−4·16	7·13	234·2
	30	141·97	1·53	6·87	2·78	7·41	247·9
May	1	154·16	1·53	7·45	−1·28	7·56	260·2
	2	166·36	1·52	7·57	+0·25	7·57	271·9
	3	178·57	1·51	7·28	1·71	7·48	283·3
	4	190·78	1·51	6·66	3·05	7·32	294·7
	5	203·00	1·50	5·78	4·23	7·16	306·3
	6	215·22	−1·49	+4·73	+5·16	6·99	317·6
	7	227·45	1·49	3·56	5·91	6·90	329·1
	8	239·69	1·48	2·32	6·37	6·77	340·1
	9	251·92	1·47	+1·04	6·54	6·62	351·0
	10	264·16	1·46	−0·24	6·44	6·44	2·1
	11	276·40	1·46	1·51	6·05	6·24	14·0
	12	288·64	1·45	2·76	5·40	6·06	27·0
	13	300·88	−1·45	−3·94	+4·51	5·98	41·1
	14	313·12	1·44	5·04	3·34	6·04	56·4
	15	325·35	1·43	6·03	2·13	6·39	70·5

Greenwich Noon.		Selenographical Colong. of the Sun.	Lat. of the Sun.	Geocentric Libration. Long. of the Earth.	Lat. of the Earth.	Amount.	Direction.
	1888.	°	°	°	°	°	°
May	16	337·58	1·42	6·82	+0·73	6·86	83·9
	17	349·80	1·42	7·37	−0·73	7·41	95·7
	18	2·02	1·41	7·61	2·19	7·91	106·1
	19	14·23	1·40	7·45	3·58	8·26	115·7
	20	26·44	−1·39	−6·86	−4·80	8·36	125·1
	21	38·64	1·38	5·80	5·77	8·18	135·0
	22	50·83	1·37	4·30	6·40	7·70	146·3
	23	63·02	1·36	2·46	6·61	7·05	159·7
	24	75·21	1·34	−0·40	6·36	6·37	176·4
	25	87·39	1·33	+1·69	5·66	5·90	196·5
	26	99·57	1·31	3·61	4·57	5·82	218·3
	27	111·76	−1·29	+5·21	−3·19	6·11	238·5
	28	123·95	1·27	6·40	−1·64	6·60	255·6
	29	136·14	1·26	7·10	+0·03	7·10	270·1
	30	148·34	1·24	7·33	1·52	7·48	281·7
	31	160·55	1·22	7·13	2·94	7·71	292·5
June	1	172·77	1·20	6·57	4·18	7·79	302·6
	2	184·99	1·18	5·73	5 20	7·73	312·3
	3	197·21	−1·16	+4·68	+5·96	7·57	322·0
	4	209·45	1·14	3·48	6·45	7·32	331·7
	5	221·68	1·12	2·22	6·65	7·01	341·7
	6	233·92	1·10	+0·93	6·57	6·64	352·0
	7	246·17	1·09	−0·33	6·21	6·22	3·0
	8	258·42	1·07	1·57	5·58	5·79	15·7
	9	270·67	1·05	2·72	4·69	5·42	30·0
	10	282·92	−1·04	−3·77	+3·58	5·20	46·4
	11	295·17	1·02	4·70	2·30	5·23	63·9
	12	307·42	1·00	5·47	+0·88	5·54	80·8
	13	319·66	0·98	6·06	−0·60	6·09	95·6
	14	331·90	0·97	6·43	2·08	6·75	107·9
	15	344·13	0·95	6·52	3·48	7·39	118·1
	16	356·36	0·93	6·30	4·72	7·87	127·0
	17	8·58	−0·91	−5·74	−5·73	8·08	135·1
	18	20·80	0·89	4·82	6·42	8·02	143·3
	19	33·01	0·87	3·56	6·73	7·61	152·2
	20	45·21	0·84	2·03	6·60	6·91	163·0
	21	57·41	0·82	−0·33	6·04	6·05	176·9
	22	69·60	0·79	+1·42	5·07	5·26	195·6

Greenwich Noon.	Selenographical Colong. of the Sun.	Lat. of the Sun.	Geocentric Libration. Long. of the Earth.	Lat. of the Earth.	Amount.	Direction.
1888.	°	°	°	°	°	°
June 23	81·79	0·77	3·06	3·76	4·85	219·1
24	93·98	−0·74	+4·48	−2·22	5·00	243·6
25	106·17	0·71	5·56	−0·57	5·59	264·1
26	118·37	0·68	6·25	+1·07	6·34	279·8
27	130·57	0·66	6·53	2·61	7·02	291·8
28	142·77	0·63	6·41	3·96	7·52	301·8
29	154·98	0·60	5·93	5·07	7·80	310·7
30	167·20	0·57	5·15	5·92	7·84	319·1
July 1	179·42	−0·55	+4·15	+6·49	7·70	327·5
2	191·65	0·52	2·98	6·76	7·39	336·3
3	203·88	0·50	1·73	6·74	6·96	345·7
4	216·12	0·47	+0·45	6·43	6·44	356·0
5	228·36	0·45	−0·79	5·84	5·89	7·7
6	240·60	0·43	1·95	4·99	5·36	21·3
7	252·85	0·40	2·98	3·91	4·92	37·3
8	265·10	−0·38	−3·86	+2·63	4·67	55·7
9	277·36	0·36	4·55	+1·21	4·71	75·1
10	289·61	0·33	5·03	−0·30	5·04	93·5
11	301·86	0·31	5·30	1·82	5·60	109·0
12	314·11	0·29	5·32	3·28	6·24	121·6
13	326·36	0·27	5·11	4·57	6·85	131·9
14	338·60	0·24	4·65	5·64	7·30	140·6
15	350·83	−0·22	−3·96	−6·39	7·51	148·3
16	2·05	0·19	3·05	6·78	7·43	155·9
17	15·27	0·16	1·95	6·75	7·03	164·0
18	27·48	0·13	−0·71	6·31	6·35	173·6
19	39·69	0·10	+0·59	5·47	5·50	186·1
20	51·89	0·07	1·88	4·28	4·67	203·7
21	64·08	−0·04	3·08	2·82	4·17	227·5
22	76·27	−0·01	+4·11	−1·20	4·28	253·7
23	88·46	+0·02	4·90	+0·47	4·92	275·4
24	100·65	0·05	5·39	2·07	5·78	291·0
25	112·84	0·08	5·57	3·52	6·59	302·3
26	125·04	0·11	5·42	4·75	7·20	311·3
27	137·24	0·14	4·96	5·71	7·56	319·1
28	149·44	0·17	4·23	6·38	7·64	326·6
29	161·65	+0·20	+3·26	+6·74	7·48	334·3
30	173·87	0·22	2·12	6·80	7·12	342·8

Greenwich Noon.		Selenographical Colong. of the Sun.	Lat. of the Sun.	Geocentric Libration. Long. of the Earth.	Lat. of the Earth.	Amount.	Direction.
1888.		°	°	°	°	°	°
July	31	186·09	0·25	+0·88	6·57	6·63	352·4
Aug.	1	198·31	0·27	−0·39	6·06	6·07	3·7
	2	210·54	0·30	1·62	5·29	5·53	17·0
	3	222·78	0·32	2·74	4·27	5·07	32·6
	4	235·02	0·35	3·69	3·04	4·78	50·4
	5	247·26	+0·37	−4·41	+1·65	4·71	69·4
	6	259·51	0·39	4·87	+0·15	4·87	88·2
	7	271·76	0·41	5·04	−1·39	5·22	105·5
	8	284·01	0·44	4·91	2·89	5·69	121·0
	9	296·26	0·46	4·50	4·26	6·19	133·5
	10	308·50	0·48	3·85	5·40	6·62	144·6
	11	320·74	0·51	2·99	6·23	6·91	154·5
	12	332·97	+0·53	−2·00	−6·70	6·99	163·5
	13	345·20	0·55	−0·93	6·75	6·82	172·2
	14	357·42	0·58	+0·17	6·40	6·40	181·5
	15	9·63	0·61	1·23	5·65	5·78	192·2
	16	21·84	0·63	2·21	4·56	5·06	205·8
	17	34·04	0·66	3·08	3·21	4·45	223·9
	18	46·23	0·69	3·82	1·67	4·17	246·4
	19	58·42	+0·72	+4·39	−0·05	4·39	269·3
	20	70·60	0·75	4·78	+1·54	5·02	287·9
	21	82·79	0·77	4·95	3·03	5·80	301·5
	22	94·97	0·80	4·89	4·32	6·52	311·5
	23	107·15	0·82	4·59	5·36	7·06	319·5
	24	119·33	0·85	4·05	6·12	7·33	326·7
	25	131·52	0·87	3·27	6·58	7·34	333·7
	26	143·71	+0·90	+2·28	+6·73	7·10	341·4
	27	155·91	0·92	+1·13	6·58	6·67	350·3
	28	168·11	0·94	−0·13	6·15	6·15	1·2
	29	180·32	0·96	1·42	5·45	5·63	14·6
	30	192·53	0·98	2·68	4·52	5·25	30·6
	31	204·75	1·00	3·81	3·37	5·09	48·4
Sept.	1	216·97	1·02	4·74	2·06	5·16	66·5
	2	229·10	+1·03	−5·38	+0·61	5·42	83·5
	3	241·43	1·05	5·69	−0·90	5·76	99·0
	4	253·66	1·07	5·62	2·40	6·11	113·2
	5	265·90	1·08	5·15	3·81	6·40	126·6
	6	278·14	1·10	4·32	5·03	6·62	139·4
	7	290·37	1·12	3·18	5·95	6·75	152·0

Greenwich Noon.		Selenographical Colong. of the Sun.	Lat.	Geocentric Libration. Long. of the Earth.	Lat.	Amount.	Direction
1888.		°	°	°	°	°	°
Sept.	8	302·60	1·13	1·85	6·51	6·77	164·2
	9	314·83	+1·15	−0·43	−6·65	6·66	176·3
	10	327·06	1·17	+0·96	6·37	6·44	188·5
	11	339·28	1·19	2·22	5·68	6·10	201·3
	12	351·49	1·21	3·29	4·65	5·69	215·2
	13	3·69	1·23	4·12	3·38	5·33	230·6
	14	15·88	1·24	4·73	1·88	5·09	248·3
	15	28·07	1·26	5·11	−0·32	5·12	266·4
	16	40·25	+1·28	+5·29	+1·23	5·43	283·1
	17	52·43	1·30	5·28	2·69	5·92	297·1
	18	64·60	1·32	5·09	3·99	6·49	308·2
	19	76·77	1·33	4·73	5·06	6·92	317·1
	20	88·94	1·35	4·19	5·86	7·20	324·6
	21	101·10	1·37	3·47	6·38	7·25	331·6
	22	113·27	1·38	2·57	6·58	7·07	338·8
	23	125·44	+1·39	+1·50	+6·49	6·67	347·0
	24	137·61	1·40	+0·30	6·12	6·13	357·2
	25	149·79	1·41	−1·00	5·48	5·57	10·3
	26	161·98	1·42	2·34	4·61	5·17	26·9
	27	174·17	1·43	3·64	3·53	5·07	45·8
	28	186·36	1·44	4·83	2·29	5·34	64·6
	29	198·56	1·45	5·81	+0·92	5·88	81·0
	30	210·76	+1·45	−6·48	−0·52	6·50	94·6
Oct.	1	222·97	1·46	6·77	1·99	7·05	106·4
	2	235·18	1·46	6·60	3·39	7·42	117·2
	3	247·40	1·47	5·96	4·64	7·54	128·0
	4	259·62	1·47	4·85	5·64	7·43	139·4
	5	271·84	1·48	3·36	6·30	7·14	152·1
	6	284·06	1·48	−1·60	6·55	6·74	166·3
	7	296·28	+1·49	+0·25	−6·35	6·36	182·3
	8	308·50	1·50	2·03	5·72	6·07	199·5
	9	320·71	1·50	3·60	4·72	5·93	217·2
	10	332·91	1·51	4·85	3·43	5·93	234·6
	11	345·11	1·52	5·75	1·96	6·07	251·2
	12	357·30	1·52	6·29	−0·40	6·31	266·3
	13	9·48	1·53	6·51	+1·14	6·61	279·9
	14	21·65	+1·54	+6·45	+2·58	6·95	291·9
	15	33·82	1·54	6·16	3·87	7·27	302·2
	16	45·98	1·54	5·68	4·94	7·52	311·1

Greenwich Noon.	Selenographical Colong. of the Sun.	Lat. of the Sun.	Geocentric Libration. Long. of the Earth.	Lat. of the Earth.	Amount.	Direction.
1888.	°	°	°	°	°	°
Oct. 17	58·14	1·55	5·03	5·75	7·63	318·9
18	70·30	1·55	4·24	6·28	7·57	326·1
19	82·45	1·55	3·31	6·51	7·30	333·2
20	94·60	1·55	2·26	6·45	6·83	340·8
21	106·75	+1·55	+1·09	+6·10	6·20	349·9
22	118·90	1·54	−0·18	5·49	5·49	1·9
23	131·06	1·54	1·52	4·64	4·89	18·1
24	143·22	1·53	2·89	3·60	4·61	38·8
25	155·38	1·53	4·23	2·39	4·85	60·5
26	167·55	1·52	5·46	+1·06	5·56	79·0
27	179·72	1·51	6·49	−0·34	6·50	93·0
28	191·90	+1·51	−7·23	−1·76	7·44	103·7
29	204·08	1·50	7·60	3·13	8·18	112·0
30	216·27	1·49	7·50	4·38	8·67	120·4
31	228·46	1·48	6·88	5·42	8·75	128·4
Nov. 1	240·66	1·48	5·75	6·17	8·42	137·2
2	252·87	1·47	4·15	6·54	7·74	147·7
3	265·07	1·46	2·21	6·46	6·83	161·2
4	277·28	+1·45	−0·09	−5·93	5·93	179·1
5	289·49	1·45	+2·00	4·98	5·37	201·8
6	301·69	1·44	3·88	3·69	5·35	226·3
7	313·89	1·43	5·41	2·18	5·83	248·0
8	326·08	1·43	6·53	−0·56	6·55	265·1
9	338·26	1·42	7·21	+1·04	7·28	278·2
10	350·44	1·41	7·48	2·54	7·89	288·8
11	2·61	+1·40	+7·38	+3·86	8·32	297·7
12	14·77	1·39	6·98	4·95	8·55	305·5
13	26·93	1·38	6·34	5·78	8·57	312·5
14	39·08	1·37	5·50	6·33	8·38	319·2
15	51·22	1·35	4·52	6·58	7·98	325·7
16	63·36	1·34	3·41	6·54	7·37	332·6
17	75·50	1·32	2·22	6·20	6·59	340·4
18	87·64	+1·31	+0·95	+5·60	5·69	350·4
19	99·78	1·29	−0·38	4·76	4·78	4·5
20	111·91	1·27	1·72	3·71	4·09	24·8
21	124·05	1·25	3·06	2·50	3·95	50·7
22	136·19	1·23	4·35	+1·18	4·51	74·8
23	148·34	1·21	5·53	−0·23	5·54	92·4
24	160·49	1·19	6·54	1·64	6·74	104·1

Greenwich Noon.	Selenographical Colong. of the Sun.	Selenographical Lat. of the Sun.	Geocentric Libration. Long. of the Earth.	Geocentric Libration. Lat. of the Earth.	Geocentric Libration. Amount.	Geocentric Libration. Direction.
1888.	°	°	°	°	°	°
Nov. 25	172·65	+1·17	−7·29	−3·00	7·85	112·5
26	184·81	1·15	7·71	4·25	8·80	119·0
27	196·98	1·13	7·72	5·32	9·36	124·7
28	209·15	1·11	7·25	6·13	9·48	130·4
29	221·33	1·09	6·30	6·60	9·11	136·5
30	233·51	1·07	4·87	6·66	8·25	144·0
Dec. 1	245 70	1·05	3·06	6·33	7·03	154·3
2	257·90	+1·03	−1·01	−5·46	5·55	169·6
3	270·10	1·01	+1·12	4·24	4·39	194·8
4	282·29	0·99	3·12	2·73	4·15	228·8
5	294·48	0·98	4·86	−1·05	4·97	257·8
6	306·67	0·96	6·21	+0·66	6·24	276·1
7	318·85	0·94	7·11	2·28	7·47	287·8
8	331·03	0·92	7·57	3·72	8·43	296·3
9	343·20	+0·90	+7·60	+4·91	9·04	303·0
10	355·36	0·88	7·26	5·81	9·29	308·9
11	7·52	0·85	6·61	6·42	9·20	314·4
12	19·67	0·83	5·71	6·71	8·81	319·7
13	31·81	0·81	4·63	6·71	8·15	325·5
14	43·95	0·78	3·42	6·41	7·25	332·0
15	56·09	0·75	2·13	5·83	6·21	340·0
16	68·22	+0·72	+0·80	+5·01	5·07	350·9
17	80·35	0·70	−0·53	3·97	4·00	7 6
18	92·48	0·67	1·83	2·75	3·30	33·6
19	104·61	0·64	3·07	+1·40	3·37	65·5
20	116·74	0·61	4·21	−0·02	4·21	90·3
21	128·87	0·58	5·23	1·46	5·42	105·7
22	141·01	0·55	6·06	2·85	6·69	115·3
23	153·15	+0·52	−6·66	−4·14	7·84	121·9
24	165·29	0·49	6·99	5·24	8·73	127·0
25	177·44	0·46	6·99	6·09	9·26	131·2
26	189·60	0·43	6·63	6·63	9·36	135·2
27	201·77	0·40	5·88	6·81	8·99	139·4
28	213·94	0·38	4·75	6·58	8·11	144·3
29	226·12	0·35	3·29	5·92	6·77	151·0
30	238·30	+0·33	−1·59	−4·86	5·11	161·9
31	250·49	0·30	+0·22	3·45	3·46	183·7
1889.						
Jan. 1	262·68	+0·28	+2·06	−1·80	2·73	228·7

These ephemerides supply the selenocentric places of the Sun and of the Earth, referred to the system of selenographical coordinates. The assumed inclination of the plane of the lunar equator to the ecliptic is = 1°·536. The computations have been made so that the last figures given can be relied on.

The geocentric libration or the selenographical position of the point on the Moon's surface which has the Earth's centre in the zenith is expressed not only by its selenographical longitude and latitude, but only by polar coordinates, of which the zero-point of longitude and latitude or the point corresponding to the centre of the lunar map is the pole. The "direction" of libration is referred to the central meridian of the map in the same way as angles of position are referred to the circle of declination, the zero-direction being that to the north pole of the Moon. The "amount" of libration is the combined effect of the librations in longitude and latitude, or the angular distance of the centre from the point which has the Earth in the zenith. A graphical representation of the libration curves for the nine lunations over which the ephemeris extends may be found in the library of the Royal Astronomical Society. The greatest librations during this period are those of

	h		°		°
Dec. 10	6	amount	9·30	direction	310·2
and of Dec. 25	17		9·38		134·0.

The selenographical colongitude (=90°—longitude) and latitude of the point on the Moon's surface which has the Sun's centre in the zenith, or, for briefness, the colongitude and latitude of the Sun serve in the computations of observations of all those phenomena on the Moon's surface which depend on the Sun's light, and they are available for the prediction of the recurrence of such phenomena as have been properly observed and timed. In a paper published in vol. xxxiii. of the *Monthly Notices*, pp. 139–156, a list, comprising 600 lunar spots, may be found, which supplies the data for determining by means of a trifling computation the Sun's colongitude, and consequently, if an ephemeris like the present one is available, the time when the Sun's centre is in the true horizon of any of these spots. When I get the next opportunity, I intend to examine all the lunar sketches in the library of the Royal Astronomical Society, and to prepare a proper list of those which deserve not to be left out and are at least approximately timed, the list being arranged in the order in which the Sun reaches the same altitudes above the horizon of the spots as at the times assigned to the sketches. I content myself at present with giving, as a specimen, a list of the sketches of M. Trouvelot, published in vol. viii. of the *Annals of Harvard College Observatory*, on Plates 4, 15, 18, and 20.

Sun's Colongitude.		Spot.	Time assigned. Camb. Mass. M.T.			Sun's Lat.	
			h	m			
321°·59 + 0·162	☉'s Lat.	Guttemberg	1872, July 9	9	0	+0°·92	Trouvelot pl. 15
333·61 + 0·075	„	Torricelli	72, Mar. 14	9	30	−1·52	4
340·02 + 0·086	„	Hypatia	72, June 11	10	0	+0·23	15
341·72 − 0·274	„	Plinius	73, Jan. 4	6	0	−1·05	18
345·29 − 0·155	„	Julius Cæsar	72, Mar. 15	9	0	−1·52	15
351·59 − 0·528	„	Linné	73, Mar. 5	7	0	−1·47	20
357·11 − 0·072	„	Agrippa	72, Mar. 16	8	0	−1·52	4
357·15 − 0·047	„	Godin	„	„		„	„
5·47 − 0·870	„	Cassini	72, Oct. 9	8	0	+1·16	18
6·84 + 0·231	„	Alphons	73, Jan. 6	6	30	−1·09	18
6·89 + 0·285	„	Alpetragius	„	„		„	„
6·94 + 0·328	„	Arzachel	„	„		„	„
15·34 − 0·258	„	Eratosthenes	72, April 16	9	0	−1·15	4
15·44 − 1·214	„	Plato	73, Mar. 7	8	0	−1·46	20
15·72 − 1·023	„	Pico	„	„		„	„
18·82 + 0·073	„	Fra Mauro	73, Jan. 7	6	30	−1·12	18
18·91 + 0·165	„	Parry	„	„		„	„
18·93 + 0·182	„	Guerike	„	„		„	„
35·72 + 0·329	„	Agatharchides	72, Sept. 12	10	0	+1·50	15
49·04 + 0·309	„	Gassendi	73, Feb. 8	8	0	−1·53	20
58·87 − 0·433	Lat.	Aristarrh	1873, Jan. 10	5	0	−1·18	Trouvelot pl. 20

In order to ascertain the time when for a spot of the list the Sun is at the same zenith distance as at the time assigned to the sketch, it is only required to multiply the Sun's latitude (taken from the ephemeris for the approximate time of the occurrence) by the factor given in the second column of the list, to add the product to the number in the first column, and to determine by reference to the ephemeris the time when the Sun reaches the colongitude thus found. Though the Sun's zenith distance will then be the same as at the time of the sketch, the effects of the illumination may yet differ sensibly, as they depend also on the Sun's azimuth, and they will therefore only agree if the Sun's latitude is the same on both occasions. Hence the necessity for the column in the list which gives the Sun's latitude at the time of the sketch.

As the daily rate of increase of the Sun's colongitude is 12°·12 to 12°·25, the ephemeris is sufficiently accurate for finding the time to about a minute. But the time thus found is merely that corresponding to the assigned time of the sketch, and any error of the assigned time is simply reproduced. M. Trouvelot's elaborate sketches must have been the work perhaps of hours, and the assigned times may differ considerably from the times

when the shadows in different parts of the sketches have actually been drawn. This may not matter much if the sketches are intended merely to be fair representations. But if the evidence of sketches is to be used in determining the heights of mountains, &c., it is clearly essential that the correct times should be stated when the shadows have actually been drawn. As a striking illustration I may perhaps refer to the latest lunar sketch which has come under my notice, Mr. Elger's interesting sketch of Plato and the region to the south of it, published on Plate x. of vol. vi. of the *Journal* of the Liverpool Astronomical Society.

The sketch represents the shadow of the spire-like pic Plato γ at a time when the point of the shadow has already quitted the crest and is on the inner slope of the opposite wall. Such an occasion affords a very favourable opportunity for procuring most valuable evidence for the determination of the differences of level between the top of the pic γ and the crest of the opposite wall and the floor of Plato. This evidence is secured by watching for and recording the times when the point of the shadow is on the crest of the wall or just quits the crest, and when it gets to the bottom of the slope and enters upon the floor, and by indicating the exact locality. Mr. Elger's sketch clearly indicates the locality, but what information is given about the time? The sketch itself is not even dated, and the time, 6h. on February 1st, 1887, which is found in the text as that when the drawing was made, is probably merely the approximate middle of the whole time expended upon the drawing. However, the time stated will at least allow the prediction of the occurrence of similar opportunities.

The Sun's selenocentric position was 1887, February 1, $6^h\ 0^m$, G.M.T., in colong. 11°·37 and lat. +0°·46. At the assumed place of Plato γ the zenith distance of that time will be reached by the Sun when the colong. is $= 11°{\cdot}92 - 1{\cdot}205 \times$ Sun's lat., and therefore, according to the data of the ephemeris, at the following times:—

1888.	G.M.T. h m	⊙'s Lat. °	1888.	G.M.T. h m	⊙'s Lat. °	1888.	G.M.T. h m	⊙'s Lat. °
April 19	11 19	−1·53	July 16	17 49	−0·17	Oct. 13	1 11	+1·53
May 18	22 47	−1·40	Aug. 15	3 3	+0·61	Nov. 11	15 27	+1·39
June 17	8 41	−0·90	Sept. 13	13 15	+1·24	Dec. 11	8 26	+0·84

But as the Sun's latitudes on all these occasions are different, the localities where the point of the shadow falls will also differ and the times will also be affected, so that there will be interesting variety; and the extension of the observations to other pics Plato δ, ϵ, ζ, Pico, &c., and, in due course, to all other interesting lunar spots, will provide observers with ample opportunities for exercising their patience and skill and for making really *useful* observations.

Comet Sawerthal, 1888. By David Gill, LL.D., F.R.S.

(*Extract from a letter to Mr. Knobel.*)

You have already heard by telegram of the comet discovered by Sawerthal. Early in the morning of February 19 he was returning from the Photographic Observatory (where he is engaged by me on the work of the *Durchmusterung*) when he saw what looked suspiciously like a comet, and he at once verified his suspicion by the aid of an opera-glass. He at once called Mr. Finlay, who had been busy comet-seeking in the early morning for the past fortnight, and a place was determined. Next morning I observed it with the heliometer, and we are now getting a strong series of observations. Approximate elements have been telegraphed home, and you will have the comet to answer for itself in the northern hemisphere about or rather before the time that this reaches you. Perihelion is on March 18.

The reflected light of the comet will now exceed $1\frac{1}{2}$ times that at the time of discovery, and, as perihelion distance is about $\frac{2}{3}$, it seems doubtful if it will become greatly brighter from increased development of tail. It will remain an early morning object during its time of visibility.

Royal Observatory, Cape of Good Hope:
1888, *March* 4.